VOL. 37, NO. 3 MARCH, 1960

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Published Monthly by the AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION,
1508 Foshay Tower, 821 Marquette Ave., Minneapolis 2, Minn.

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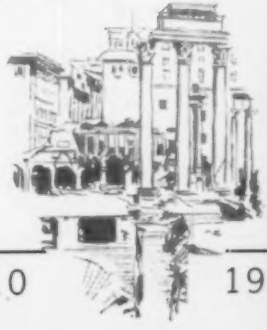

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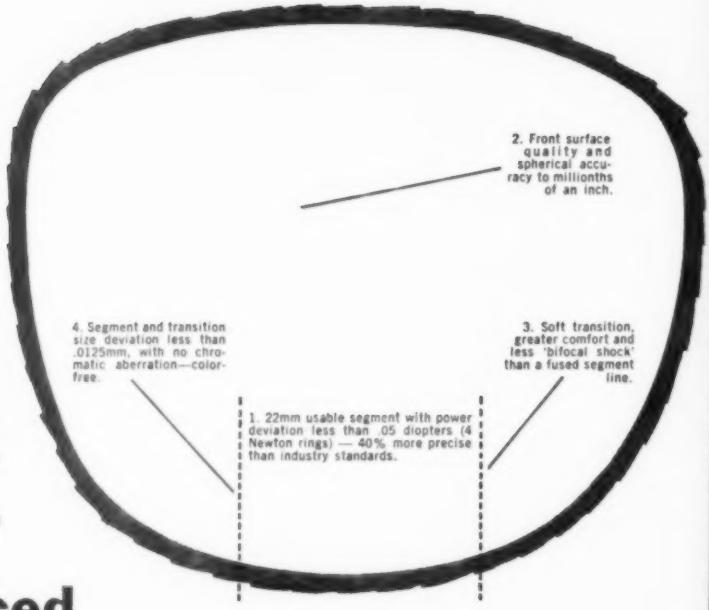
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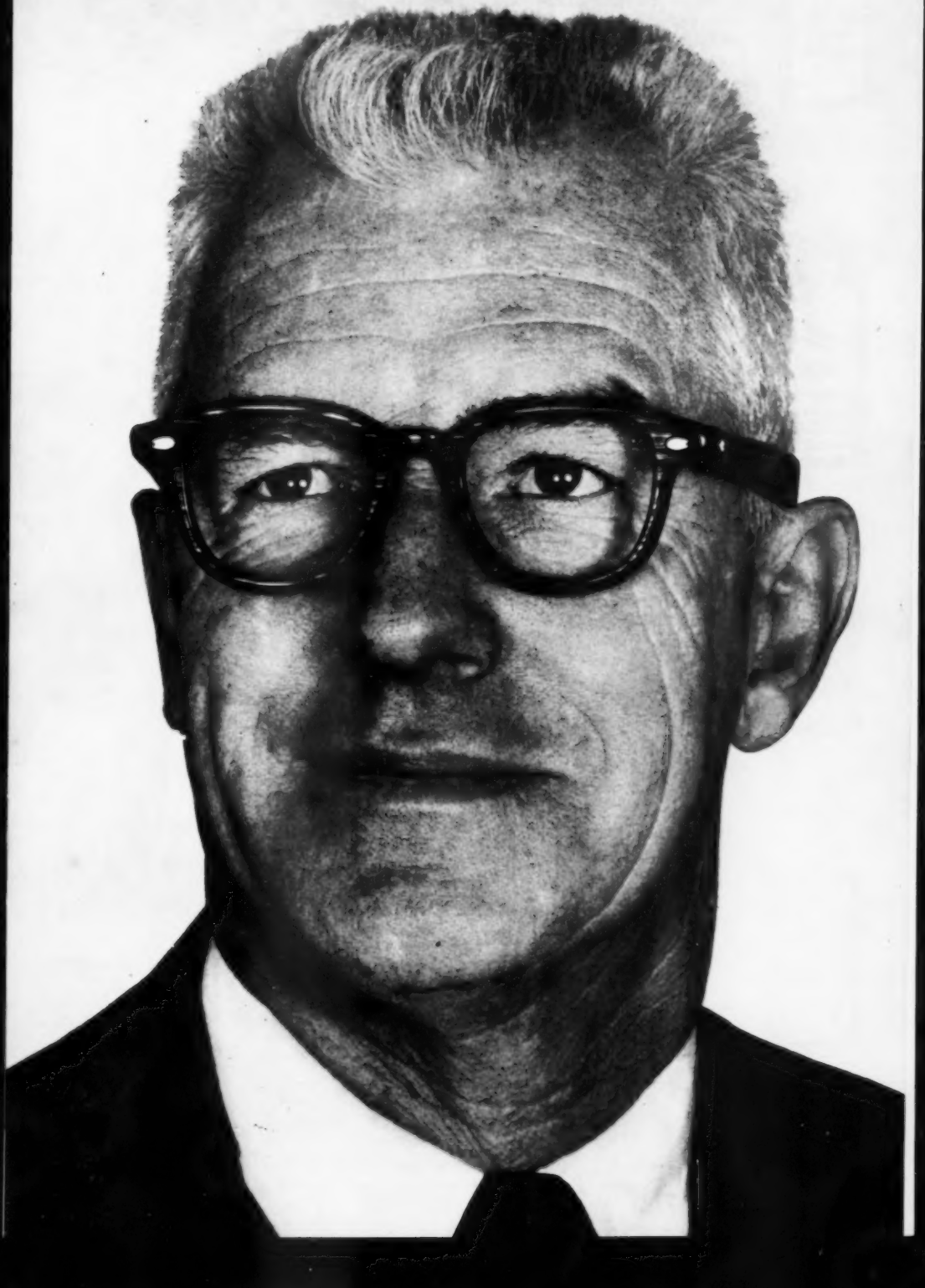

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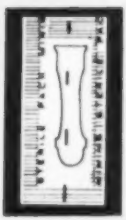

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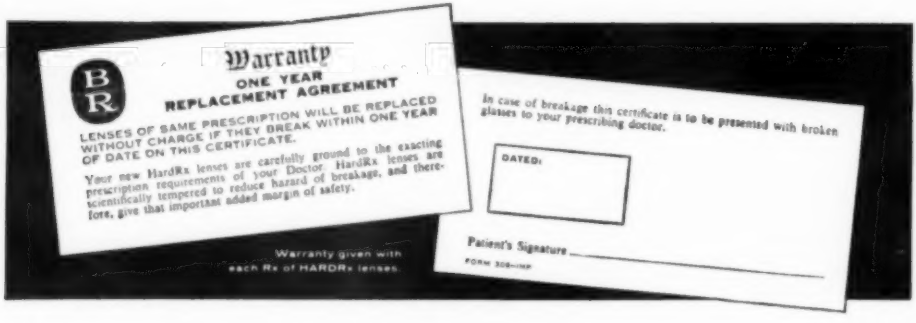
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Vol. 37 March, 1960 No. 3

# A REVIEW OF DARRELL BOYD HARMON'S EXPERIMENTAL RESULTS*

Monroe J. Hirsch†
Ojai, California

INTRODUCTION:

This paper is a review and evaluation of some of Darrell Boyd Harmon's early writings as they pertain to vision and visual defects only.**

Harmon's work as it applies to optometry and optometrists may be summarized as follows:

(1) Visual data on a large group of children were obtained. An increase in the frequency of vision defects was noted with increased age, and it was concluded that the child's environment in school contributed to these defects.

(2) A better environment, called the Coordinated Classroom, was devised and experiments were performed to demonstrate that children placed in this environment developed fewer visual defects (as well as other defects not of concern here) than children in the less desirable older type classroom.

(3) Harmon is currently interested in a theory of vision. He has within the past year produced an impressive volume of "Notes on a Dynamic Theory of Vision."[1] This theory is not yet in its final form.

In the first phase of his work, Harmon's reports were published in journals not usually read by optometrists. For the most part, therefore, optometrists' knowledge of this phase of the work has been limited to summaries which appeared later.†† Two of Harmon's reports of

*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 13, 1959. For publication in the March, 1960, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

†Optometrist, Fellow, American Academy of Optometry.

**Harmon's work has touched upon and been of interest to those in the fields of education, nutrition, pediatrics, medicine, nursing, dentistry, illuminating engineering, physiology, psychology, social work, and others. An evaluation of the extent of Harmon's contribution to a particular field can best be made by one with an understanding of his own branch of knowledge. If the present author appears immodest in undertaking to evaluate this work as it pertains to vision, he may be credited with realizing his limitations in the other disciplines.

††Many optometrists' knowledge of the early phases of Harmon's work results from exposure to brief statements like the following: "Dr. Harmon directed studies of over 160,000 children demonstrating effects of improper lighting, seating, decorating

this phase of his work will receive close scrutiny in the present paper. One report on the second phase will be considered, mainly in the light of the earlier studies. The third phase will not be considered at all. Harmon's theory is complex and is not in final form. It merits separate and complete review.

HARMON'S PRELIMINARY STUDY — 1942:

Harmon served as director of the Division of School Health Services of the Texas State Department of Health between 1937 and 1947. During this period data for 160,000 school children were amassed. The first paper* (in so far as we are able to determine) dealt with experimental results and appeared in the Public Health Section of THE MEDICAL WOMEN'S JOURNAL.[3] This paper seems to have been intended to serve only as a first report: it was titled "Some Preliminary Observations on the Developmental Problems of 160,000 Elementary School Children." However, we have encountered no subsequent analysis of these data, and this paper is cited in many of Harmon's later studies. In so far as the data on the 160,000 children are concerned, this paper is both preliminary and final.

In this first paper the following statement, which is to become the major theme in much of Harmon's later work, appears:

> *Sensory Defects*—The final tabulation of the observations showed that approximately 10 percent of the children entering the first grade in the schools studied, started with clinical organic eye defects. At the end of the first school year, it was found that approximately 20 percent of the children were not seeing adequately or properly. At the end of the third grade approximately 50 percent of the children were having difficulties of seeing to a clinical degree, and at the end of the elementary school period . . . (fifth or sixth grade depending upon the particular school) . . . 90 per cent of the children were seeing with distortions approximating clinical problems.

These figures are not in agreement with those reported by other investigators nor with the clinical experience of most ophthalmic practitioners. Values suitable for comparison are found in the definitive Orinda Study of Blum, Peters and Bettman.[4] This cooperative venture of public health, optometry, and ophthalmology was meticulously performed and the data subjected to more complete analysis than those of similar earlier experiments. These authors report that:

> The incidence of vision problems increased with age at a rate of approximately 1.6 percent per year. Of the age group 5-6-7, 18 percent had vision problems, which increased to 31 percent in the age group 13-14-15.

By interpolation from the Orinda data, approximately 27 per cent of the 12 year old children were classified as having a defect in vision.

---

and arrangement in classrooms on the health, development and learning of school children." [2] Statements similar to this and containing little more information have appeared dozens of times in the optometric literature and folklore within the past decade.

*We are grateful and express appreciation to the staff of this journal for help in tracking down obscure bibliographic material. Our special thanks to editor Carel C. Koch and bibliographic editor Grace Weiner for their help in this regard.

Harmon described 90 per cent of the fifth and sixth graders (whose age may be assumed to be approximately 12 years) as having vision defects. We reject at the outset the hypothesis that this difference between 90 and 27 is due to everything in Texas (including the number of eye defects) being larger than everything in California. Therefore, we may seek an explanation in the description of an eye defect, and here we shall begin.

In the Orinda Study, the criteria of vision problems are expressed in the familiar terms of visual acuity, refractive error, coordination (phoria or tropia) at 20 feet and at 16 inches, and organic pathology. Pass and fail values for each category were established on the basis of a study of the frequency distributions and the clinical interpretation of the optometrists and ophthalmologists engaged in the project. The criteria were validated by a questionnaire sent to optometric and ophthalmological clinicians.*

While the tests administered, the criteria selected, and the methods of validation of the criteria are all mentioned in the Blum, Peters and Bettman report, this is not the case in Harmon's preliminary paper. It will therefore be necessary to examine Harmon's statements carefully in an attempt to learn how he classified children as having eye defects. All of the quotations in the remainder of this section are from Harmon's paper cited earlier.[3] Early in this paper, Harmon states the following:

> It was seen from the beginning that it would be virtually impossible to make complete medical, psychometric, education, and social studies of every child that would be included in the studies. Therefore, a method of studying the children within each school system had to be evolved which would assure a reasonable degree of accuracy and yet would expedite the accumulation of the total data.

We interpret this to mean that the 160,000 children were observed, not measured or tested. Harmon was aware that the validity of such a procedure depends upon an assumption, and this he carefully stated:

> In order to devise a practical method of observation, an assumption was set up and approved by the advisory groups, which would guide the construction of the techniques to be used.

*The questionnaires were sent to 630 members of the American Academy of Optometry and 500 ophthalmologists (members of either the Pacific Coast Oto-Ophthalmological Society or the American Academy of Ophthalmology in the eastern states). Each clinician was asked to state what value for each category he considered to be a basis for correct referral regardless of whether or not he would institute treatment. Blum, Peters and Bettman conclude that while ". . . the ophthalmologists indicated higher values for the referral criteria . . . the agreement of the middle 50 percent was remarkably good." Thus, the Orinda Study delineates "eye defects" on the basis of specific scores on specific clinical tests with the criteria determined by the research team and validated by clinicians in the two clinical eye professions. While the question was put to the respondents in the form of basis for correct referral, it is reasonable to conclude that clinicians will want any significant defect to be referred.

Harmon named the fourteen advisory groups, and the list includes five teacher or education groups, three nurse's groups, the dental society, the state Parent-Teacher Association, the state medical society, pediatric society, neurological society, and the illuminating engineering society. Whether the approval of these groups has any significance in evaluating a basic assumption pertaining to theoretical or clinical physiological optics is questionable. Rather than attempt to answer such a question, the assumption will be considered here. Harmon states it as follows:

> . . . This assumption, related both to acceptable biology, and to a monistic educational philosophy, was that "the child is a unity," or the mind is the body in action. More specifically, this assumption was construed to include the concept that the child's behavior in any given situation would reflect, or be complementary to, the physiology involved. Using this assumption as basic, the collected observations of the child in action in the classroom should define his health, psychological, and experimental limitations within areas sufficiently defined to allow for initial medical and educational interpretation. Observations would include a study of all of the physical and psychological factors in the classroom that would act as effective stimuli on him, and the purposeful educational stimulation in the immediate learning situation with the responses to that situation. Necessarily the data should be analyzed as a problem of dynamics, rather than a problem of medical or psychological diagnosis leading to therapy.

Harmon's general assumption is that a child's behavior in certain situations will reflect or be complementary to the physiology involved. More specifically, he proposes to observe the child's behavior in the classroom and obtain information about such phenomena as eye defects. Optometrists will immediately agree that this assumption has some degree of validity, for a case history is based upon a similar assumption. The optometrist uses the description of the child's behavior offered by the parent, teacher, or nurse as one method of diagnosing eye defects. The major difference, however, between optometric procedure and Harmon's procedure is that the optometrist uses these observations *plus* clinical testing; Harmon uses observation only. The assumption will be considered again later.

After the assumption had been accepted by the advisory groups, Harmon established his criteria in the following manner:

> To have a starting point for the observations, an initial list of some seventy-five individual signs and symptoms of physiological, physiopathological, psychological, and educational significance were constructed by making frequency tables of the syndromes in those respective areas which were commonly accepted by the pediatrician, the clinical psychologist, the clinical educationist and the social worker. The staff working on the project were trained to recognize these signs in individual children when observing a classroom in action.

Unhappily the list of 75 signs and symptoms is not presented in this or any subsequent paper located by this reviewer. No data on the reliability of the method (ability of two observers, for example, to arrive at the same conclusions about the same child) are offered here or in subsequent papers. We can only guess as to what bases for observa-

tion were used, and such a speculation will be offered later. Harmon did attempt a form of clinical validation in the following manner:

> . . . The list of signs was then adjusted by having clinicians from the above areas make diagnostic studies of groups of children who had been checked by the staff observers. This validation was continued until the observers' accuracy had been established at a point where at least seven out of ten children they screened out as showing signs and characteristics would have the deviation to which those signs were related, and where all of the children in the classroom who had the specific syndromes being sought would be included in the seven out of ten each.

This description is self-explanatory. The "seven out of ten criterion" will be referred to subsequently. Harmon further describes his validation procedure as follows:

> From time to time as numbers of children became sufficient in the various areas of classification to permit more accurate, intensive studies, groups falling within these classifications were selected by various clinicians who analyzed the major factors entering into the specific clinical problems involved. To illustrate: when some two thousand children were found who were classified as nutritional problems, quantitative nutritional tests were made on these children by staff and volunteer pediatricians. Their data was (sic) correlated with information on educational and social activities. Similar clinical studies were made on groups with ophthalmological problems, problems of bodily asymetry, and the like. Although effort was made to secure large enough groups of children with defects for the clinical studies to be reasonable samples of the total, no exact statistical control was maintained.

Thus, the children were classified by observation, and some of those classified as having defects were given clinical tests. The nature of these tests and the criteria used for measuring defects are not stated. The number of children so tested and the degree of agreement are not stated. The two quotations just offered are all that is mentioned about validation, other than a statement that the classifications were readjusted during the three years of the study on the basis of trends found and their significance to interprofessional areas. No subsequent paper was found which offered more definitive data on the clinical testing procedure.

Harmon's technique for classifying children as having defects in the five categories (of which "eye defects" is one) may now be summarized:

(1) A list of signs and characteristics of behavior of children in the school situation is drawn up.

(2) Since the "mind is the body in action," it is assumed that physiological deviations may be detected by observing the child in the classroom.

(3) This assumption is approved by the advisory groups.

(4) As data are accumulated, the syndromes are changed until at least 7 of the 10 children classed as having a defect will have it, and no children with the defects will be missed.

(5) Clinical testing was performed upon an unspecified number of children and the observational technique altered to gain closer agreement.

(6) A large number of children were observed using the observational technique, and these subjects were categorized as to defects.

EVALUATION OF HARMON'S TECHNIQUE

Several aspects of Harmon's technique may now be discussed:

(1) The assumption that there is some degree of relationship between behavior and existence of defects is probably valid. The degree of relationship, however, may be questioned. Harmon reports having performed a type of clinical validation but has failed to state the clinical tests used, who performed them, the number of children tested, and the statistical degree of correlation between clinical testing and observational technique. Since these data are not offered, we must seek evidence in other places:

(a) In school vision studies in which nurses' and teachers' observations were compared to clinical findings (St. Louis Study of 1952,[5] for example), the observational technique is found to be the poorest method of determining those children with vision defects. The degree of relationship is very low.

(b) Clinical experience, already mentioned, would indicate that relationship exists but that the degree is low. Most optometrists see numbers of children who have such symptoms as blinking, for example, which are not attributable to vision defects. They also are accustomed to see such defects as suppression which may manifest no behavioral deviation. On the basis of clinical experience most optometrists would insist upon the most rigid validation of the thesis that a one-to-one relationship existed between behavior and eye defects.

Harmon's basic assumption, then, can only be accepted as being partly true. Since it is at variance with both common experience and with other studies, it demands a degree of validation which has not been offered.

(2) Even were the assumption valid, one still might question whether Harmon's behavioral criteria were valid. Unfortunately, Harmon has not presented either the original list of 75 signs and symptoms or the revised list finally used. This is unfortunate, since optometrists on the basis of their experience might be able to tell a great deal about the experiment if they knew what signs were observed.

It should be clear that an experimenter may, in complete innocence and with no intention of doing so, rig an experiment at the outset. For example, in the present instance one might describe frowning as a sign of defect. In a classroom with a great deal of extraneous light, a child might frown. Altering the light would cause frowning to disappear and would lead one to conclude that the defect has been

removed. The clinician would immediately point out that we have only demonstrated that poor illumination can produce frowning: he would deny that frowning is always indicative of a defect.

Whether Harmon's results are dependent upon such phenomena as that used in this example, we cannot say. The importance of the experimenter listing his criteria, however, is obvious. Without these we can only regard the experimental results with the greatest degree of skepticism: they are not in agreement with other results, and the basis upon which they were derived is unknown.

(3) It is possible that Harmon has arrived at a list of signs and symptoms which is vastly superior to that used by nurses, teachers, and optometrists at the present time. Although this possibility seems remote, it should be explored. Such a list of signs and symptoms which bore a one-to-one relationship to vision defects would be invaluable. It could be placed in the hands of teachers and nurses and would solve the entire school vision screening program. There would be no need for screening devices or for professional screening if observation could detect all children with defects.

Clearly, one of two things is true, but not both. One is that Harmon has in fact devised a set of signs which will accurately classify children as having defects. In this event it is most unfortunate that this technique has not been made available to the professions. The other is that the technique is no more valid than similar observational methods used by teachers and nurses at present. If this is the case, then Harmon's results are no better than his method, presently conceded to be the poorest method of assessing visual defects.

(4) The number of subjects cited in this study is 160,000, and so large a number is impressive. However, it should be obvious that the accuracy of the method will not be determined by this large number but by the smaller number who received the clinical examination and upon the degree of agreement between the clinical and the observational technique.

For example, if we observed one child who had blue eyes and myopia, we might then classify a million children by eye color, stating the number of children with myopia. Our estimate, however, would not be based upon a million cases. It would be as good as, but no better than, the one observation. The large number of children observed must not lull the reader into a feeling of false security. The chain is still only as strong as its weakest link. How weak this link is we cannot say, for Harmon has not reported the number of children given clinical validation. The number, however, is much less than 160,000.

## A RECONCILIATION OF HARMON'S DATA WITH OTHERS

Having studied Harmon's methods, we may now again turn to his statement that 90 per cent of the fifth or sixth grade children had eye defects. This statement follows:

> . . . Of the total group, 41 per cent of those in the upper division of the elementary schools had visual problems related to organic eye lesion and 49 per cent had visual problems that were symptomatic of lesion in some other area than the eye. Through the clinical processes indicated above, it was shown that this 49 per cent group included those who had developed bodily asymmetries which so disturbed their eye relationships with their materials in close work that a violation of the principles of physical optics were (sic) produced. Others in this 49 per cent were being restrained by seating, improper lighting, or improper placement of materials for eye-hand preferences, so that proper relations in the area of good physical optics were so disturbed that they were being conditioned in errors of imagery.

Thus, of the 90 per cent who had vision defects, 41 per cent are related to an organic eye lesion, while 49 per cent are defects symptomatic of a lesion elsewhere. Since Harmon is not specific as to what is the difference between these, we shall make some assumptions and then check his findings against those of others. We shall make the following two assumptions:

(1) That the 41 per cent who have eye defects indicating an eye lesion are those who have defects according to the criteria of an ophthalmic clinician. The 49 per cent who have eye problems symptomatic of a lesion somewhere else are those who have eye signs or symptoms in their behavior but no clinical eye problem.

(2) Harmon stated that his list of signs were adjusted so that at least seven out of ten children who were screened out did in actuality have the deviation. Thus, in any group classified as having a deviation, we are sure only that 70 per cent of these have the defect: 30 per cent probably do not have the defect.

If these two assumptions are correct, then 70 per cent of the 41 per cent classed as having eye lesions will in fact have eye defects. This would be 29 per cent and is in very close agreement with the 27 per cent found by the Orinda group for a similarly aged group. This close agreement tends to support the validity of our assumptions. We may now summarize the status of the fifth and sixth grade children whom Harmon examined, 90 per cent of whom were said to have defects in vision:

(A) Children with no defects:

| | |
|---|---|
| Classified by Harmon as having no defect | 10% |
| Classified by Harmon as having a defect (but in actuality not having a defect) | 27% |
| This group includes 30 per cent of the 90 per cent who were improperly classified as a result of the "7 out of 10 criterion" established. | |
| Total number with no defect | 37% |

(B) Children with an eye defect 29%

Harmon found this number to be 41 per cent, but the "7 out of 10 criterion" indicates that only 70 per cent of the group actually have an eye defect. This figure now is in agreement with optometric experience and with the results of other studies.

(C) Children with eye signs but no eye defect 34%

This would be 70 per cent (due to criterion) of the 49 per cent who were said to have such a lesion.

This third group seemingly consists of children whom a clinician would categorize as having no defect in vision, but whom Harmon classifies as having a defect on the basis of behavior. The problem resolves itself to one of semantics. For example, if a child stubs his toe and cries, does he have "a visual problem . . . symptomatic of lesion in some other area than the eye"? He has a visual problem (lacrimation) caused by a lesion (bruised tissue) in an area other than the eye (the toe). Harmon's statement indicates that bodily asymmetries were a prominent cause of visual problems in this group. It would seem that bodily asymmetries which caused no clinical visual defect should be classified as bodily asymmetries rather than as eye defects.

On the basis of the foregoing discussion, it is seen that the high number of children classified by Harmon's study is dependent upon two characteristics of his experimental method: (a) A set of signs used in classifying which will identify seven children with eye defects for every ten classified as having a defect; and (b) The classifying of all children with vision signs and symptoms as having vision problems or eye defects. The list of signs and symptoms (never presented) very likely include signs such as frowning at glare, not customarily considered to be signs of eye defects.

HARMON'S RESULTS — 1944 AND 1949:

The second phase of Harmon's work was an attempt to reduce the number of defects by placing the child in a school environment which became known as the Co-ordinated Classroom. Some of the results which were to be quoted again and again in later papers were first presented at the Illuminating Engineering Society Technical Conference in 1944 and were published the following year in *Illuminating Engineering*.[6] In 1949, Harmon authored a monograph entitled the "Co-ordinated Classroom"[7] which was published by the American Seating Company.* In this monograph the results of the 1944 paper are cited. These two papers form the basis for the present review.

In a footnote at the beginning of the 1944 paper, Harmon discusses the nature of his data:

Complete analysis of all of the data has not yet been made. These and other

*This was revised in 1951 and the later edition was used in preparing this review.

figures that follow are preliminary tabulations only. They were made by the author for use in this paper and are not refined so they should not be considered an official release of the Texas State Department of Health. Final analysis of medical data in this paper, together with descriptions of medical techniques and medical interpretations is to be published later under proper medical auspices.

At the end of 1944, therefore, Harmon was aware that final analyses of the data and descriptions of the techniques were needed. Some description is offered early in the 1944 paper, and three paragraphs are cited in full. The first paragraph, a synopsis of the technique, seems to be in close agreement with our analysis in the preceding section. Harmon states:

> In making our inventory of the health status of Texas children, we revised a bit the usual medical concept of what constitutes a health problem. The conventional concept of health as the absence of clinical disease is unquestionably too narrow for use in defining procedures for promoting optimum effective functioning of the human organism. For this purpose health must be conceived as including not only freedom from disease but also the capacity to realize all the organism's inherent potentialities for growth and development, to function efficiently in meeting the basic demands of group living, to reconcile organic needs with social requirement, to meet common stresses without damage, and to go through extraordinary health hazards with a minimum of lesion. For the purpose of our study a health problem was enumerated regardless of clinical degree whenever that health problem could be demonstrated to be deviating the child's school performance from his measured capacities.

Here, Harmon seems to be using the same technique as in his first study. The paragraph which follows, however, introduces a new note:

> Details of the techniques of the many tests and experimental procedures we used, derived from the fields of pediatrics, ophthalmology, dentistry, medical nutrition, dietetics, psychometry, anthropometrics, engineering, etc., to check the status of the children in our intensive study centers would probably be of no interest to illuminating engineers. It is probably sufficient to say that each of the examiners met the highest standards of their (sic) various professional fields; the procedures used were approved by the professional groups making up our advisory commission; and the children were checked with sufficient frequency to determine as accurately as possible their health status and what was taking place within them as a result of the new methods developed.

On first reading, one might conclude that the procedures were clinical ones and that the examiners were, in the case of the eye, for example, ophthalmologists. However, reading this paragraph carefully and recalling the previous study, one realizes that probably this is the same technique formerly described. The procedures, it will be noted, were "derived from" the various fields. Thus, the signs and characteristics used in the observational technique as applied to the eye were signs "derived from" ophthalmology. The further statement that the examiners met the highest standards of their professional fields is ambiguous. It is not clear whether the examiners in the case of the eye, for example, were professional ophthalmic practitioners who had met the highest standards or whether they were public health nurses, educationists, or others trained in observing children and who were well qualified in their fields. Harmon's third paragraph in this section is most difficult to interpret in the light of the previous discussion. It follows:

> These tests revealed the tentative fact about children I presented to you earlier. They showed that 59.0 per cent of the Anglo-American children in the elementary schools have refractive eye defects or various disturbances that are affecting or distorting their visual sensation. (A footnote to this point states: "Determined by manifest examination—not done under a cycloplegic.") It is interesting to note that in the first grade only 18 per cent of the children had these defects. This percentage increased to 40 per cent in the third grade and by the end of the elementary school period, the number of children leaving the elementary school having eye defects was 82 per cent. There were a number of eye defects disturbing visual sensation that were not related to refraction. Thirty-nine per cent of our elementary school children had eye defects in this category. (A footnote to this point states: "From slit-lamp examination of anterior eye.")

This citation and its footnotes are verbatim and complete, and no further descriptions of the testing are to be found in this or the later paper. The sections involving the footnotes deserve very careful scrutiny.

Harmon speaks of "refractive eye defects or various disturbances that are affecting or distorting their visual sensation." The symbol for the footnote "determined by manifest examination" appears after the word, "sensation." It is this reviewer's belief that Harmon intended it to refer to the words, "refractive eye defects." A statement in the 1949 paper seems to bear out this conclusion. In this later paper, Harmon states:

> . . . The visual tests were in terms of the difficulties affecting the children's work in school, so they did not necessarily indicate that all the children found with visual difficulties required glasses. The tests did indicate that some factor existed preventing these children from "seeing" in their classroom work like children whose eyes met accepted standards for normal vision.

From these citations we may conclude that Harmon's subjects with anomalous vision had either refractive defects *or* a disturbance of the visual sensation. In other words, two different groups of anomalies are combined. Now, when Harmon states that 59 per cent of these children have poor vision, we do not know how many of these are refractive and how many are suffering from distorted sensation. We are adding peaches and apples together, a perfectly permissible procedure so long as we do not refer to the sum as "apples." We may ask, "What does Harmon call the result?"

The answer to this question seems to depend upon the date. In the 1944 paper in Harmon's Table IV, 53.3 per cent of the children are shown to have "Refractive Eye Problems" before they received the benefits of a co-ordinated classroom; after six months, only 18.6 per cent of the children had such defects. In Figures 59 and 60 of the 1949 paper, we discover that 53.3 per cent of the children had "Visual Difficulties," and this, too, became 18.6 after being in the co-ordinated classroom. Clearly, the fact that the numbers are identical must mean that these are the same experimental results. However, in 1944 they

are described as "Refractive Eye Defects," while in 1949 they are "Visual Difficulties" which an explanatory paragraph points out are not necessarily refractive.

These subjects are defined differently in the two papers, although their numbers are identical. It is this reviewer's opinion that the later description is more accurate and that Harmon's subjects with anomalies included both those with refractive difficulties and those with distorted visual sensation. Furthermore, although Harmon does not offer any clue or hint as to how many of each group there were, this reviewer would venture a guess.

In a group of similar age, approximately 15 to 20 per cent of the children will have refractive defects according to most available data. It is our belief that, of Harmon's sample, approximately 18 per cent had refractive defects and 37 per cent had distorted visual sensation. Harmon threw these together and found 53 per cent with defects. After these children spent six months in the co-ordinated classroom, we guess that the 18 per cent who had refractive errors still had their refractive errors: the 37 per cent who had distorted sensations are those who were "cured."

We do not know the nature of the "distorted sensations." The material in the first section of this review offers some information on which to base a guess. These children may have had some sign or symptom such as frowning or blinking which was a reaction to glare and which disappeared when glare sources were removed. Not knowing the signs used, we cannot say if this is so or not. Whatever the case, however, it is this reviewer's opinion that Harmon's experiments offer no evidence that any change in refractive defects occurred in his experimental group. On the contrary, the fact that Harmon's data invariably show a frequency of defects *after* co-ordinated classroom of the same magnitude as the frequency of refractive defects found by most other investigators could indicate that he has freed his experimental population of all defects *except* refractive defects.

In passing, it might be noted that in the 1944 paper Harmon reports that 4.2 per cent of the children had no eye defects upon entering the co-ordinated classroom but showed a defect after six months. We would guess that a fair proportion of these were newly developed refractive errors. These subjects are not mentioned in the 1949 paper.

We may return now to a consideration of the group of children who had anomalies according to slit-lamp examination. In Table V of the 1944 paper under the heading of "Non-Refractive Eye Problems," the experimental results for this group are presented. Before entering

the co-ordinated classroom, 39.5 per cent of the children had such defects and six months later, only 3.8 per cent had similar defects. In many of the grades the total number with the defect after co-ordinated classroom was zero.

These startling results do not appear in the 1949 paper, nor again in later papers in so far as we can determine. Thus, the 1944 results labeled "Refractive Eye Defects" appear by 1949 to have become both refractive and non-refractive. The 39 per cent of the children who in 1944 had "Non-Refractive Defects" as diagnosed by the slit-lamp seem to have become unworthy of reporting.

Since we know nothing about the nature of the slit-lamp observation, we can only summarize these results in the form of a riddle: "What is it that 39 per cent of the grade school children in Texas had in their anterior eye when examined by the slit-lamp and that disappeared almost completely after the child had spent five hours of each day for six months in a well-planned classroom?" Any answer this reviewer might offer would be purely speculative.*

COMMENTS OF OTHER SCIENTISTS:

In the preceding sections the present reviewer has been critical of Harmon's failure to describe his methods and criteria. Although the present review is perhaps the most comprehensive one devoted solely to this subject, other scientists have expressed concern and the need for proof of the validity of Harmon's techniques. Three such comments will be cited here.

At the end of Harmon's paper there was discussion by those who attended the conference, and this is included in the printed paper.[6] Mathew Luckeish, who commented favorably upon the general results, interjected this note of caution:

> . . . I am surprised that the effects which Dr. Harmon attributes to glare and to asymmetrical distribution of light and brightness have apparently been isolated so readily and that the percentages are so large and apparently so decisive. To examine these results critically one must know more of the actual criteria and techniques. The Illuminating Engineering Society is scarcely the proper forum for such a discussion and Dr. Harmon wisely refrained from dealing with the details of criteria, techniques, data, etc. However, some of us will await with interest the reactions of experts in the sciences involved, for such work must eventually be adequately examined and appraised.

This was in 1944, and now, 15 years later, the "experts in the sciences involved" have still not been able to examine or appraise the work. The descriptions and data necessary for such an evaluation have still not been presented.

*Although Harmon offers no clue whatever, the thought occurs to this reviewer that the diameter of the vessels of the conjunctiva could have been the variable which was studied. If this is the case, and a physical correlate to subjective asthenopia exists, what a shame that optometrists have learned nothing about it! Such a finding might easily be Harmon's most important contribution to physiological optics.

Luckeish in his discussion of this paper also offers the following astute observation:

> Although a life-long association with researches in seeing has prepared me to expect more and more revelations of the deleterious effects of poor seeing conditions, I am surprised that the relatively small fraction of each twenty-four hours during which the child is *harnessed* to an asymmetrical visual environment could have such pronounced results.

This reviewer shares Luckeish's surprise. As a student of refraction, this reviewer is accustomed to meeting the claim that the removal of one or another environmental stress will prevent the development of eye defects. Harmon's results, however, go far beyond this: two-thirds of his subjects with eye defects were "cured" or freed of their defects by spending "a relatively small fraction of each twenty-four hours" in the co-ordinated classroom. Harmon cannot possibly be speaking of defects as the clinician knows them, and in fact he has in most of his papers stated this. Unfortunately, some clinicians have interpreted the results as indicating true eye defects: Harmon's use of such terms as "manifest refraction" and "refractive eye defects" has not helped the clinician in his understanding, nor has his failure to state unequivocally what was the nature of the defects.

At the same conference, the physiologist and professor of medicine, A. C. Ivy, also stated the need for further descriptions:

> It is difficult to provide an appreciation of Dr. Harmon's paper without more factual data than those presented. . . . a more detailed analysis of the data would be more convincing to most ophthalmologists and physiologists.

Huelsman[8] set up an experimental classroom according to Harmon's standards to test Harmon's hypothesis. He reported his findings at a Reading Conference in Chicago in 1951. In discussing the Harmon hypothesis which he was testing, Huelsman criticizes certain of Harmon's statistical procedures which are "not generally accepted," and then states:

> . . . Since Harmon has treated most of his data in this fashion it is not possible to appraise them critically. Furthermore, Harmon has omitted two other kinds of information from his discussion. He has not named or described the tests used to arrive at the data, and he has not provided information regarding what happened to the control children during the same period.

By 1951, Huelsman was troubled by the lack of description of Harmon's tests. It might be noted incidentally that Huelsman repeated Harmon's experiments with regard to the effect of the co-ordinated classroom on certain of the mental abilities of children and failed to confirm Harmon's results.

EVALUATION OF HARMON'S EXPERIMENTS AS THEY AFFECT OPTOMETRY:

On the basis of the preceding discussion, certain critical aspects of Harmon's experiment may be summarized:

(1) For the most part, Harmon identified eye defects by an observational technique, the classifiers being trained in public health or education but not in the ophthalmic professions.

(2) The criteria or signs used have not been reported, and we can only guess at their nature. This reviewer has ventured the guess that normal reactions to such phenomena as glare may have been included among these signs.

(3) Some clinical validation was attempted but we can learn neither the tests used nor the number of children included in the validation studies. The clinicians were probably ophthalmologists.

(4) The degree of relationship between clinical studies and observational techniques is not stated. Harmon does speak of adjusting the signs to achieve a certain degree of reliability, namely: at least seven actually having the defect for every ten enumerated. This overclassification undoubtedly explains in part how Harmon came to find so many more defects than other investigators.

(5) In his various papers, Harmon has described the same groups as having defects of a different nature. This reviewer has expressed the opinion that defects of different types were considered together: that portion of the group who were not favorably affected by the co-ordinated classroom probably was the group with refractive problems.

(6) Harmon's figures for the incidence of eye defects *before* co-ordinated classroom are greatly in excess of the frequency found by other investigators: his figures *after* co-ordinated classroom are very close to agreement with those of others. Based upon examination of these results, this reviewer concludes that the environmental change may well have removed all defects *except* the clinical or refractive defects.

We may now consider briefly what effect this work has upon optometry. With regard to scientific physiological optics, these results can have no effect. The request for details made by Luckeish and by Ivy when the results were first presented has not been answered. Results of experiments so poorly described and so incompletely analyzed cannot be accepted no matter how startling they may appear.

If experimental results are to be accepted, they should conform to the same rigid standards whether their application is to be theoretical or clinical. Harmon's results, therefore, should be regarded with the same degree of skepticism in the clinical situation as in the theoretical one. Sometimes, however, clinicians fail to apply standards to suggested results as rigid as the standards of science require.

Thus, if we consider the situation as it exists, we find that some clinicians have accepted Harmon's findings as valid: without examining

the evidence, they have attributed conclusions to this work which are not warranted. Most clinicians have been skeptical of these results; a few have accepted and expanded them.

Having seen the short description of Harmon's work, or having read some of his later papers, some clinicians have arrived at this understanding: Harmon *examined* (rather than observed) 160,000 children. There was among these children an alarming increase in the number of *eye defects* (not signs) with increasing age. Altering the environment removed the *eye defect* (instead of sign), and therefore effected a change in the eye.

The clinicians' misinterpretation has resulted not from what Harmon said, but from what he did not say. The clinician misinterpreted because he was bombarded by the same sketchy synopsis over and over again while the experimental results (incomplete though they are), appeared in lesser known (at least, to the optometrist) publications, like the MEDICAL WOMEN'S WORLD, where they were not available to his scrutiny.

Thus, Harmon's results, if not accepted by scientists, have at least become a part of optometric folklore. They are then expanded. If eye defects can be removed by manipulation of the environment, why then not use lenses or exercises as an environmental factor? Harmon's results are interpreted as proving that "function alters structure." This review has noted that this is an incorrect interpretation and has stated instead that these results demonstrate that "function alters everything *but* structure." Nonetheless, these results have had an effect on some optometrists' thinking.

The reason for Harmon's failure to publish his results has also become a part of optometric folklore. The most frequent explanation is that a fire destroyed all of the data. This reviewer is most sympathetic to any experimenter whose data become lost. However, many of the questions which Harmon's results do not answer are not dependent upon data sheets. The techniques could have been described (even if from memory) in much greater detail. This reviewer feels that some knowledge of the criteria, the types of defects enumerated, the clinical tests used, and similar facts must have survived any fire.

It should again be stressed, as it was at the beginning of this review, that we have considered only a small part of Harmon's total work. What effect the co-ordinated classroom has on mental ability, tooth structure or spinal curvature, we would not presume to state.

With respect to vision we find no evidence in Harmon's papers to justify the conclusion that the co-ordinated classroom or any other

environment in any way alters refraction or eye structure. Rather, the evidence seems to indicate the reverse. The obscurity and incompleteness of Harmon's data have contributed to the introduction of such a concept into optometric folklore: the data themselves, however, only demonstrate that environment probably does *not* alter eye structure but does alter certain undescribed behavioral signs, the nature of which remain known to Harmon alone.

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## INSTRUMENT REVIEW

### THE HOLMES SLIDE RULE

The Holmes Slide Rule is a convenient and very useful slide rule adaptation of the ranges of clear vision used to compute multifocal needs of the patient. The unit was copyrighted by W. Clark Holmes in 1956 and produced under the auspices of R. E. Conn, Jr., Vice President of Vision-Ease. The Slide Rule supplements Holmes' Guide to Occupational and Other Visual Needs. The unit is 9 x 12 inches, laminated for permanent use, and makes the vivid colors most attractive for "chair-side" utilization by the occupational-conscious optometrist. Most highly recommended for routine daily use. Available from the Diederich Optical Company, Los Angeles, $1.50.

G. P. ELMSTROM, O.D.

# LENS PRESCRIPTIONS AND ORDERS FOR EYEWEAR*

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## INTRODUCTION

The present-day optometrist offers what can be termed a unified service which consists of (1) examining his patient's eyes, (2) designing whatever eyewear is necessary, (3) procuring the necessary ophthalmic materials from an optical laboratory, (4) adjusting the completed eyewear to the patient's face, and (5) providing subsequent service. He seldom hands his patient a prescription to be filled by someone else. In essence he fills his own prescription by supplementing his examination findings with additional facial measurements and writing an order for a pair of spectacles which he sends to an optical laboratory.

Many optometrists erroneously refer to this as a lens prescription, but traditionally a lens prescription is a limited set of specifications which is given to the patient and which he in turn takes to a dispensing optician. The dispensing optician "fills the prescription" by making additional facial measurements and then writing the order for a pair of spectacles which is sent to the optical laboratory. Another arrangement is to have the prescription filled by an assistant working under the optometrist's supervision. Even when the optometrist does the whole job by himself one can think of this operation as broken down into two phases: (1) the derivation of a prescription from the examination findings, and (2) the translation of the prescription to an order for a pair of spectacles which must be based upon additional facial measurements.

As long as one man does the whole job, it is not too critical which specifications are considered to be a part of the prescription and which are a part of the order. However, when one man writes a prescription and another man fills it, the roles of the two men have to be defined more precisely. In every case the optometrist who writes the prescription is privileged to include in the prescription whatever he chooses. Some optometrists might want to include a specification of P. D. or a specification of the displacement of the top of the segment below the major reference point. Others may be satisfied to include a bare minimum of specifications in the prescription, but what constitutes a bare

*Submitted on December 17, 1959, for publication in the March, 1960, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
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minimum? One approach to the answer is to ask just how many of the specifications the law permits or ought to permit a dispensing optician to determine. Our state laws are not specific on this point and all that I can do is to express my own personal opinion as to what should constitute the bare minimum.

It is hoped that this expression of opinion will stimulate comments. Ultimately it is to be hoped that the optometric profession can reach an agreement as to what constitutes a bare minimum to be included in a prescription which a patient is free to have filled by a dispensing optician.

It must be acknowledged that the legal and educational status of the dispensing optician varies from state to state and in attempting to define the bare minimum one must keep in mind the states where the status is low. The minimum for a prescription will change as the status of the optician changes, but at any given time the optometrist and the optician can communicate better if each understands what is expected of the other.

The reaction of the average optometrist to the introduction to this paper will be to ask why the author is so concerned about this matter when there are so few prescriptions sent out by optometrists. I am actually not concerned about how many prescriptions are sent out to be filled, because as long as optometrists are willing to fill their own prescriptions they should be encouraged to do so. However, the situation in which one man writes a prescription and another man translates it into an order for a pair of spectacles provides a dramatic breakdown between two phases of an operation which get confused when one man does the whole job.

Therefore for the clearness of exposition, if for no other reason, we shall discuss this problem in terms of an optometrist who writes a prescription and a dispensing optician who fills it. This is the most dramatic way to call attention to the unique problems involved in translating a prescription into an order for a pair of spectacles.

Not only is it necessary to define what constitutes a prescription, but it is even more important to spell out what constitutes a complete order for the optical laboratory.

My primary concern at the moment is the establishment and maintenance of a system of standards and tolerances for the optical laboratory, and to implement such a system requires a clear definition of what constitutes a complete order. It is essential not only for fabrication, but also for checking the ophthalmic material supplied to the dispensing optician by the optical laboratory. When the dispensing

optician releases the spectacles to the patient, the optometrist who wrote the prescription may be called upon to check to see if the prescription has been properly filled. This involves a very different process than checking the material supplied to the dispensing optician by the optical laboratory.

THE ITEMS TO BE INCLUDED IN A PRESCRIPTION

(a) *The Lens Formula.* This usually includes a specification of sphere power, cylinder power and cylinder axis. These powers apply to a thin lens mounted normal to the line of sight at a certain distance, say 14 mm. from the cornea or 27 mm. from the center of rotation, but this is not written out in the prescription. A more subtle problem arises in connection with the cylinder axis. Because of the torsion associated with changes in convergence and direction of regard the cylinder axis can apply only to one given amount of convergence and direction of regard. The logical combination of convergence and direction of regard to use for this purpose is the one in which the lines of sight are parallel and are at zero azimuth and depressed six degrees below the primary plane of regard.* No allowance is made for lack of parallelism between the base line and the face plane in the case of differential protrusion of the two eyes in writing the prescription. In the case of squinters and one eyed people no assumption can be made about the amount of convergence, but it may be assumed that the cylinder axis for a given eye applies when the eye is at zero azimuth and 6° of depression when accommodation is relaxed. The cylinder axis specification is based on the base line connecting the two centers of rotation and no deviation from this is made in the case of hyper eye. In the case of one eyed people it is necessary to estimate where the center of rotation of the second eye would be if it were still intact.

(b) *Object Distance.* Unless otherwise specified it is assumed that the lens formula makes the retina conjugate to an object at six meters (approximately 20 ft.) when accommodation is relaxed. It may be specified that the pair of lenses is for "distance," but this means six meters. The pair of lenses may be prescribed for use at "near only" and unless specified to the contrary it is assumed that "near" applies to objects at sixteen inches. A given prescription may specify separate formulas for "distance and near" which implies two object distances, one at 20 ft. and another at 16 inches.

*When the eyes are pointed in these directions their lines of sight pass through the major reference points of the lenses mounted in front of them. The determination of the cylinder axis in the examination room is made at zero elevation, but the eyes undergo no torsion in turning down six degrees.

The optician has no choice about the 20 ft. object distance and must provide a lens which will conform to the formula within ±0.12 D. This encompasses the range from 3.5 to 20 meters; it does not include the stars or distant objects in an ordinary landscape. Furthermore the optician cannot without a prescription add minus power to compensate for night myopia which occurs in night drivers.

The optician should have no choice about the "near" object distance. The optometrist or ophthalmologist who writes the prescription should take the time to determine what add or adds and what object distance or distances ought to be used in designing the eyewear. These should be specified in the prescription. He should also specify for what the lenses are to be used.

The optometrist or ophthalmologist should decide whether the patient should have bifocals, trifocals or a multiple number of pairs of spectacles for different distances.

When the optometrist indicates that trifocals rather than bifocals should be used, he must indicate both the reading and the intermediate add. These come in fixed combinations. The optician may be allowed to select the type of trifocal, when there are several types which give the desired adds.

(c) *Prism Power.* Prism power and the direction of the base may also be included in the lens formula. The power implied is the power of a thin flat prism held in contact with the thin lens which represents the lens formula.

(d) *Magnification.* If the magnification is left unspecified the optician is allowed to select the vertex distance, the base curve and center thickness without being limited to a specific value for magnification.

If per cent angular magnification is specified as a correction for aniseikonia this is done in terms of an overall power, a meridional power and axis. This does not imply an absolute value for each of the two eyes, but differences in per cent magnifications for the two eyes. Furthermore it is understood if magnification is specified that the lens formula applies to a combination of magnifiers and precision trial lenses of a specific design and arrangement before the eyes.

(e) *Color.* If the color is not specified, the optician has the privilege of selecting any color he feels the patient should have. If the optometrist or ophthalmologist wants a specific color or no color at all he must so specify, and once this is specified the optician has no choice in the matter.

(f) *Reflections.* The prescription may call for the optician to pay attention to the problem of flare images and edge reflections without

suggesting a solution to the problem. The optician must design the eyewear to control this problem.

(g) *Aberrations.* If the examiner discovers that the patient is having difficulty with the distortion or chromatic aberration with his old lenses, these facts should be called to the attention of the optician.

THINGS WHICH OUGHT NOT TO BE INCLUDED IN THE PRESCRIPTION

Where we can assume that the optician is properly trained there are many decisions about the design of the eyewear which he should make. If a vertex distance is included in the prescription it should be understood that this merely defines the prescription because some distance has to be specified or assumed for this purpose, but the optician should be free to reinterpret the prescription in terms of some other vertex distance if this better suits the needs of the patient. If no vertex distance is specified, it is assumed that the prescription is based on a vertex distance of 14 mm.

The prescription should impose no restriction upon the angling of the lens, the center thickness or the base curve. The prescription should not include the specification of lens size or shape because this also unduly restricts the optician. It follows from this that the prescription cannot specify the position of the major reference point or a segment, nor should the position of the segment be specified with respect to the major reference point.

ORDERS SUBMITTED TO THE OPTICAL LABORATORY

The order for a pair of spectacles which the optician writes and sends to an optical laboratory is quite a different thing from a prescription.

It is impossible to emphasize too much the difference between a prescription and an order. The optician must exercise considerable judgment in the interpretation of the prescription. Even the lens formulas have to be changed if the vertex distance implied or specified does not conform to that used in the final design. The cylinder axis may be different on the order as compared with the prescription to compensate for hyper eye. The reading addition may have to be different because the specification on the order must conform to the laboratory method of measuring the power of the addition.

There are many major decisions which the optician must make in designing the eyewear. He must select the base curves and center the lenses. He must choose the bridge size and the size and shape of the lenses, the size, shape and locations of the segments, the vertex distances, the angling of the lenses, and must choose the location in each lens for the major reference point. All of these decisions affect the optical performance of the lenses.

On the other hand the order submitted to the optical laboratory represents a complete set of specifications and leaves the worker in the optical laboratory with no choices to make.

INSPECTION OF EYEWEAR SUPPLIED BY AN OPTICAL LABORATORY

It is easy enough for the optician to inspect a piece of eyewear which he has received back from the laboratory to determine if his order has been properly filled. He can make a separate check to see if the eyewear fills the prescription given to him by an optometrist.

A set of standards and tolerances for lenses used in fabricating eyewear such as the AOA Rx Standards and Tolerances can be used by the dispensing optician in checking the eyewear and lenses supplied to him by the optical laboratory. A new set of standards and tolerances is being prepared by the Z-80 committee of the American Standards Association which can be used both by the optical laboratory and the dispensing optician. Once approved and published optical laboratories will have to meet these standards and tolerances in order to have their work certified as first quality.

REFERRING THE PATIENT BACK TO THE OPTOMETRIST

Many optometrists insist on having their patients referred back to them routinely and this should be clearly understood by the patient and the dispensing optician, but in any event if the patient has difficulty with the glasses which obviously is not the fault of the glasses per se, the patient should be returned to the optometrist. It would be helpful if the optician were to send to the optometrist a copy of the order which was sent to the optical laboratory.

CHECKING THE EYEWEAR

It is not too difficult for an optometrist to check a pair of glasses to see if it conforms to his prescription. As a matter of fact he may use the same procedure which he uses in evaluating at a first visit whether a pair of lenses already worn is adequate. If, in checking the pair of lenses, the optometrist finds that the optician has made an error in his calculations or has used bad judgment in the design of the eyewear, he should return the patient with specific written instructions or suggestions for the redesign of the eyewear. On the other hand, he may find that he needs to change the prescription.

THE ADVANTAGE IN HAVING THE OPTOMETRIST FILL HIS OWN PRESCRIPTION

If an optometrist fills his own prescriptions this simplifies checking and trouble shooting. It also saves some time at the outset because much of the case history explored during the refraction has to be repeated by the optician if two men are involved.

Another very satisfactory arrangement is to have an optician associated with an optometrist in the same office.

SUBNORMAL VISION AIDS AND CONTACT LENSES

What has been said above applies to ordinary ophthalmic lenses mounted in spectacle frames and mountings. The problems of subnormal vision aids, magnifiers and contact lenses are very complicated and will be considered in subsequent papers.

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# THE USE OF THE WORD PRESCRIPTION IN OPHTHALMIC OPTICS*

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THE DISTINCTION BETWEEN PRESCRIPTIONS AND ORDERS

In a previous paper[1] I have attempted to differentiate between a prescription which might be written by an optometrist and filled by a dispensing optician, and an order for eyewear written by a dispensing optician and sent to an optical laboratory.

When an optometrist dispenses his own eyewear, one can think of his function as broken down into two phases: (1) he examines a patient's eyes and writes a prescription, and (2) he then fills his own prescription and thus plays the role of a dispenser. In this paper I propose to use the term dispenser to designate both the dispensing optician and the optometrist or ophthalmologist who dispenses his own ophthalmic prescriptions.

An order for a pair of spectacles submitted to an optical laboratory should not be referred to as a prescription even though the spectacles have been designed to fill a prescription. It is the dispenser who fills the prescription.

The lens formula on an order blank should not be referred to as a prescription. The lens formula on the order blank is not necessarily the same as the lens formula in the prescription. Optometrists, dispensing opticians and optical laboratory personnel should not allow themselves to get into the careless habit of regarding the two things the same.

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*Submitted on December 17, 1959, for publication in the March, 1960, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

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PRESCRIPTION EYEWEAR, CUSTOM-MADE EYEWEAR AND OPTICAL MERCHANDISE

The expression prescription lens should be restricted to lenses which a layman cannot procure without a written prescription from an ophthalmologist or optometrist. For example, prescription sunglasses are differentiated from plano sunglasses because they contain power and hence cannot be obtained without a written prescription. The amount of power required in a lens to make it a prescription lens must be defined by state laws or agents empowered by state laws to make such decisions.

In the field of drugs it is quite common for a physician to prescribe the use of aspirin. Does this make aspirin a prescription item? According to the criterion that a prescription item is something which can be procured by prescription only, aspirin is not a prescription item because it can be sold without a prescription. In the same sense an optometrist may prescribe a pair of plano sunglasses, but this is not a prescription item.

Eyewear can be classified as follows:

A. Custom-made eyewear.
    1. Prescription eyewear.
    2. Custom-made eyewear which does not require a prescription.
B. Optical merchandise.

As pointed out earlier an optometrist may prescribe plano sunglasses, but this does not make such a pair of spectacles prescription eyewear.

Without having a prescription a dispensing optician can design a pair of plano sunglasses to fit a specific face and to function properly for the pair of eyes in question. In this case it constitutes a custom-made piece of eyewear.

Custom-made eyewear has to be differentiated from optical merchandise, which can be used by different people. Sunglasses sold indiscriminately to various people without reference to P.D., bridge size, or temple length must be regarded as optical merchandise. A pair of binoculars with an adjustable interocular distance is also a good example of optical merchandise.

When the day comes that no one is so poor or handicapped by misfortune that he cannot provide for himself the best available eyewear for his needs, any optical device worn constantly before the eye or pair of eyes should be prescribed and custom-made. However, that day has not yet come and until then we shall have to differentiate between prescription eyewear, custom-made eyewear and optical merchandise.

WHEN DOES A LENS BECOME A PRESCRIPTION ITEM?

A simple answer to this is that it becomes a prescription item when a dispenser inspects it after it has been delivered to him by the optical laboratory and he accepts it as satisfactory for filling a given prescription. In a certain sense a lens is a prescription lens if it contains power, but it does not become a prescription lens until it is accepted for filling a given prescription. Up to this point it is merely ophthalmic material capable of being used in filling a prescription.

THE PROPER NAME FOR AN OPTICAL LABORATORY

There appears to be no reason at all for referring to an optical laboratory as a prescription laboratory. In the first place it fills orders, not prescriptions, and secondly, the custom-made eyewear which it fabricates and supplies is not limited to prescription eyewear, but includes custom-made plano sunglasses and plano safety glasses.

The name optical laboratory suffers from the fact that it implies the manufacture, fabrication or repair of all kinds of optical devices other than ophthalmic lenses and eyewear.

If a given concern distributes or repairs optical instruments and equipment used in performing eye examinations and also fabricates custom-made eyewear it is usually called an optical company. The optical laboratory is a part of the company. Optical instruments are also distributed by suppliers of scientific instruments.

An optical laboratory could also be called an eyewear laboratory. The word eyewear actually includes such things as artificial eyelashes which would not ordinarily be handled by an optical laboratory, but this could hardly present a problem.

Ophthalmic laboratory is another possible name for an optical laboratory, although this might suggest a place where ophthalmic ointments are compounded. Ophthalmic lens laboratory suggests that the glazing of lenses to frames has been excluded.

Optical laboratory seems to be the best name at the moment and since these are used primarily by dispensing opticians, optometrists and ophthalmologists who are familiar with the scope of the activity, no confusion can arise.

PRESCRIPTION OPTICIANS

Some dispensing opticians refer to themselves as prescription opticians, because they consider it their primary function to fill prescriptions. This is a very proper use of the word and is thoroughly consistent with what has been said above. The use of this name would not necessarily restrict them from dispensing non-prescription custom-made eyewear or selling optical merchandise.

It would also be possible, however, to use the term prescription optician to designate one who restricts his activity to filling prescriptions.

At an earlier period the names prescribing optician and dispensing optician were used to differentiate the optometrists from the dispensing optician, but in this country the name prescribing optician is now obsolete.

In England the counterpart of the American optometrist is called an ophthalmic optician and in this way is differentiated from the dispensing optician.

MISUSE OF THE WORD PRESCRIPTION IN THE OPTICAL LABORATORY

It is common practice for an optician to identify a particular order by using the patient's name and this kind of label plus the designation of right or left eye is used to keep lenses and pieces of eyewear separated from each other. So far so good, but it turns out that anything which gets a patient's name assigned to it also gets called a prescription item. This includes laboratory finished uncut bifocals, completed units of eyewear, invoices and orders.

All of these uses of the word prescription are improper; they can be and should be avoided.

The term prescription lens is often used to designate a laboratory finished lens as opposed to a factory finished uncut lens. A factory produced semi-finished lens becomes on this basis a prescription lens when a second surface is finished in the optical laboratory to make it conform to some specific person's lens formula. One might deduce from this that a prescription lens must have one or both surfaces ground or polished in an optical laboratory, but this is not the case. It is the fact that it gets assigned to some particular patient that provides the only justification for calling it a prescription lens.

This is borne out by the fact that when a factory finished uncut lens is used in fabricating a completed piece of eyewear, it also becomes called a prescription lens when it is cut and edged to fill an order with somebody's name attached to it.

If a factory ground uncut lens is sold to a dispenser who wants to do his own laboratory work it becomes a stock item and is then differentiated from a similar lens which is used by the laboratory itself in filling an order for a completed unit of eyewear to be worn by a named person and which is therefore called a prescription lens.

The same kind of differentiation is made between prescription prices and stock prices.

Why not call items finished in the laboratory, laboratory items to differentiate them from stock items? The prices could be called laboratory prices and stock prices.

The terms laboratory finished, laboratory ground, factory semi-finished and factory finished could be used to differentiate finer shades of meaning.

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## COMMENTS ON "DYNAMIC MYOPIA"*

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I have read with interest Anderson's article on "Dynamic Myopia"[1] and, as one of the authors cited in a minor way, feel moved to comment briefly on it. The introduction, defining a dynamic system, is a useful reminder to optometrists and ophthalmologists who too often are careless in their use of physical terms. The insistence on the importance of longitudinal studies is also sound.

The application of the physical concepts introduced seems less rigorous. The "stress" of "near visual tasks" assumed to differ in intensity between the school year and vacation were not quantified in any of the papers cited nor is the question of polarity clear. Is the "more" or "less" time devoted to near tasks a difference in polarity, or is the polarity between "near" and "far" tasks? If refractive differences are proved to be associated with the school year and vacation, the effective nature of the "stress" of near work is not thereby established, since there are other "stresses" that vary with the time of year, such as temperature, sunshine and food; the presence of yearly cycles of growth in height and weight of children, long known, testify to their importance.

Of the three papers cited as bearing on the assumption that near work is a "stress" factor in a dynamic system of myopia, one is rated by Anderson as favorable, one opposed and one inconclusive. This hardly justifies even the tentative statement of the author that "they might be said to show the existence of a dynamic component," particularly in view of the immense bibliography of, for instance, Stansbury.[2] Thus, Holm[3] compared the refraction of 926 literate and 376

*Submitted on December 1, 1959, for publication in the March, 1960, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.

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illiterate members of a genetically homogeneous group of natives of Gabon in Africa. There was no significant difference between either the mean refraction or the frequencies of the various refractive states. Actually the small differences present indicated more myopia among the illiterates who had not attended school. Among others might also be mentioned the work of Witte[4] who analyzed the records of over 30,000 persons, some of whom (students, etc.) did much near work and others (farmers, etc.) very little. The genetic homogeneity of the group was not considered and appears very doubtful, but taken at face value the following confusing results emerge: Low grade myopia (1 to 5 D., incl.) is significantly more common among students but high grade myopia (6 to over 20 D.) is significantly more common among farmers. Thus low myopia appears to be a dynamic system responding to the stress of near work by an increase in numbers but high myopia a dynamic system becoming more common in the *absence of near work*.

Anderson states that the view that myopia is the result of a "too long eyeball" is "fallacious." He states that in Sorsby's work, it is shown that with few exceptions, values for axial length, corneal power, and lens power, of the order commonly seen in emmetropia, recur in the ametropias up to ±4 D. These eyes are ametropic, not because of any abnormal constituents, but because of faulty correlation of the individual components, and the degree of ametropia is the measure of the degree of faulty correlation." The overwhelming proportion of emmetropia and low ametropia in the general population is striking proof that the process of growth is regulated and orderly. That the use of the eyes might be a factor in this regulation of growth has been part of the belief of many men since Herman Cohn[3] first noted the increase of myopia with successive grades in the schools, and although many careful reviews of the evidence, such as that of Stansbury,[2] fail to find any serious evidence for the effect of near work in producing myopia, any individual is entitled to further experimental investigation.

That physical principles underlie biological phenomena has been the credo of many biologists since Descartes, but the naive application of such physical principles is beset with many problems, as the optometrist or ophthalmologist in practice is well aware. The proposed experimental study rests on the "known progression of the corrected myope" (the myopia rather then the myope is usually thought of as progressive). No evidence is adduced as to how common or extensive such "progression" may be; all modern studies indicate that it is far less common and extensive than the phrase "known progression" suggests. The proposed longitudinal study of myopia, or better of the whole

gamut of refraction, with and without correction might well give important results, but the unrealistic proposal of random fitting with plus and minus lenses would raise such a storm among parents who want their children "saved" from myopia that only the temerity of youth would suggest it and then in a vague and distant form. The convincing experiment is still to be devised and supported since it will be both long and expensive.

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## ANNOUNCEMENT

### SPEAKERS AT A.O.A. MEETING IN ATLANTA, GEORGIA

The speakers and their subjects at the 63rd Annual Congress of the American Optometric Association, Biltmore Hotel, Atlanta, June 26-29, will be as follows:

Contact Lenses. Neal J. Bailey, O.D., Columbus.

Aids for Partially Sighted. Alfred A. Rosenbloom, O.D., dean, Illinois College of Optometry, Chicago.

Refractive Procedures. Merrill J. Allen, O.D., Ph.D., Division of Optometry, Indiana University, Bloomington.

Practice Management. Frederick Kushner, O.D., Sheldon, Iowa.

Visual Training and Reading Achievement. Harold M. Haynes, O.D., Pacific University, College of Optometry, Forest Grove, Oregon.

Dispensing Procedures. John Archer, O.D., Los Angeles College of Optometry, Los Angeles.

Detection of Pathology for Referral. Paul F. Shulman, Illinois College of Optometry, Chicago.

Vocational Prescribing. Charles A. Abel, O.D., Los Angeles College of Optometry, Los Angeles.

Pre-School Vision. R. W. Lowry, Jr., Worthington, Minnesota.

Economics of Optometric Practice. Myron L. Shoffner, O.D., Los Angeles.

Professional Salesmanship. Louis Jaques, Sr., O.D., Los Angeles.

# A FEASIBILITY STUDY OF ULTRASONIC TONOMETRY*

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## INTRODUCTION

Our present understanding of the nature of glaucoma through increased knowledge of gonioscopy, better understanding of the physiology of aqueous out-flow, and tachistoscopic perimetric techniques, serves only to emphasize a need for standardized units of intra-ocular pressure measurement. Such a quantitative measure can be obtained only with a tonometer.

It was felt that a reliable, non-contacting, non-irritating tonometer would be of tremendous value to the twenty thousand optometrists in the United States, performing nearly 75 per cent of the visual examinations, who are, for the most part, limited to non-anesthetic scleral tonometry. It would be equally useful to public health officials and persons interested in industrial eye care who have felt the need for a calibrated system of investigating intra-ocular tension without need for anesthesia. The study reported here was undertaken to determine the feasibility of developing such a tonometer.

In general this study has been conducted in two phases. Phase One involved a literature search, the object of which was to establish the current status of investigation and development by others in the field of electronic tonometry. This phase attempted to answer the question of whether or not there have been previous efforts in this direction and if so, has any previous effort established conclusively whether the subject instrumentation is feasible or not.

The outcome of Phase One justified embarking on Phase Two. Previous effort by others did not indicate infeasibility, therefore the possibility of developing a tonometer like that described was investigated further.

This report attempts to present the status of this investigation at

*Read before the annual meeting of the American Academy of Optometry, Chicago, Illinois, December 12, 1959. For publication in the March, 1960, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
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the time of termination and to provide a conclusion based on the findings to date.

PHASE ONE

The literature search provided evidence of wide spread application of, and experimentation with, ultrasonic energy in the field of medicine, both as a therapeutic and a diagnostic tool. In general, the applications of ultrasonics fall into four catagories: (1) as an experimental laboratory device, (2) as a radiant energy in physical therapy, (3) as a selectively destructive agent, and (4) as a diagnostic tool.

While more research effort has been devoted to therapeutic uses, the object of this investigation was a diagnostic device, and the initial literature search was more or less confined to papers whose titles indicated close alliance with the field of optometry.

Oksala and Lehtinen have been extremely active in the diagnostic application of ultrasonics in the field of ophthalmology, publishing papers on the diagnosis of detachment of the retina, investigation of the structure of the vitreous body, location of foreign bodies (even bodies invisible roentgenologically), the application of ultrasonics as a diagnostic tool in ophthalmology in general, and others.[20, 25, 29, 30] Additional published papers have been reviewed by the authors on the subjects of ultrasonics in cataract research[2] and the application of ultrasonics in general to the fields of medicine and biology,[4, 6, 7, 21, 23, 27] as well as accounts of national and international symposia and conferences on this subject.[31]

After exhausting references which directly linked ultrasonics, diagnosis, and the eye, the more recent (past 5 years) literature on the subjects of tonometry, tonography, and glaucoma (including a summary of all papers on glaucoma '57-'58) was investigated.[9, 12, 13, 14, 15, 18, 19, 24, 26, 28]

In every instance of published work it appears that the diagnostic application of ultrasonics to the eye has been limited to the detection and investigation of *interfaces* of different tissues and liquids, both pathological and normal, within the eye, or to locate foreign bodies. In particular, two important points appear to be common to all works: (1) where ultrasonics was used, the transmitting medium between the energy transducer and the eye (or head, where indirect approaches were used) was something other than air, and (2) there was no hint of an association of tonometry or glaucoma with ultrasonics.

Baum has given us significant information[33] on the range of dosage which may be safely employed about the eye. While his work provided somewhat limited information in that a variety of frequency and pulse duty cycles were not investigated, particularly in view of the uneven

distribution of sound energy on the emitting surface of the transducer and the fact that biological effects vary greatly at different levels of the ultrasonic spectrum, it does provide a "ball park" level about which investigation can commence.

The above investigator, using rabbits' eyes, indicated a safe range of exposure of 0.25 Watt/cm²/5 minutes to 1.0 Watt/cm²/5 minutes or an equivalent sound output of 2.5 to 5.0 Watts at a frequency of 1 Megacycle/second. Reversible effects were produced at a range of 1.5-2.0 Watts/cm²/5 minutes and irreversible pathologic changes occurred at 2.5-3.0 Watts/cm²/5 minutes. The apparent linear relationship between time and power as demonstrated by this investigation suggests higher energy levels could possibly be employed using short pulse durations. The possibility of cataract or other effects secondary to ultransonic radiation were not considered in this article.

As a final effort to uncover the works of others in the subject field, a number of Universities and resident physicians who were associated with the field were contacted. In every instance but one, (Dr. M. F. Armahly, Dept. of Ophthalmology, University of Iowa) it appears that while these people are doing research with ultrasonics in a variety of applications, none had an interest similar to ours.

PHASE TWO

The opinion of a number of authorities, as uncovered in the literature search, that it is impossible to transmit ultrasonic energy from a piezoelectric transducer to a tissue through air, the universal use of a coupling medium such as oil or degassed water in all previous research, and the complete absence of previous consideration given the subject application of ultrasonics, could have been interpreted as a deterrent to further investigation. However, realization that the first mentioned obstacle is based on relative rather than absolute practicality, and the appearance of one article[34] in the literature which describes an application of ultrasonic energy dependent on air to water transmission for successful performance, gave enough encouragement to initiate Phase Two.

Since this particular article was instrumental in a decision to continue research, it is worthy of a detailed explanation. A system is described which is capable of automatically tracking and providing elevation and azimuth information of salmon tagged with an ultrasonic oscillator. In operation, the tracking system "homes" on an ultrasonic transmitter attached to the fish, thus-aiming the highly directional "shipboard" ranging transducer, located approximately 3.5 feet above the water level, directly at the fish. The echo ranging system depends on the transit time of pulsed energy from the transducer to return from the

fish, and a knowledge of the angle of water entry provides fish depth.

Detailed circuit configurations are discussed in the article: however, there is no provision for blanking the echo amplifier during the return from the air-to-water interface or any means of correcting for the refraction that occurs at this interface.

Upon a decision to continue investigation, thorough consideration of the inherent characteristics of ultrasonic energy and of the measurement to be made suggested three possible techniques to provide a solution. From the start, it was apparent that each had only a remote chance of success.

First, let us consider the fact that the velocity of ultrasonic waves in any medium varies with the pressure condition of that medium, velocity increasing with increasing pressure. This characteristic might be used to advantage in several different ways. If the sound could be made to travel the same distance in all eyes, the transit time to an interface would serve as a measure of the pressure of the optic media.

A more realistic approach is as follows: since acoustic impedance is a function of velocity, and since the inflection from an interface is a function of the acoustic impedances of the two media involved, then the amplitude of return from an interface is a function of pressure. The equations relative to these properties are:

$$Z_a = PC \quad A_r = \frac{Z_{a1} - Z_{a2}}{Z_{a1} + Z_{a2}} A_a \qquad (32 — p.\ 18)$$

where $Z_a$ = acoustic impedance
$P$ = density of material
$C$ = velocity in the material
$A_r$ = amplitude of reflected energy
$A_a$ = amplitude of incident energy

and subscripts (1) and (2) refer to the two different acoustic media forming the interface.

One system for instrumenting this technique would make use of relative measurements. Two pulses of ultrasonic energy could be transmitted simultaneously, one directed at a reference sample with perhaps the durometer of a normal eye (or at some other reference pressure), the other at the eye in question. Comparison of the two returns in a differential amplifier would result in an output proportional to the difference in pressure between the reference and the unknown.

A second possible solution involves the fact that in addition to the alternating pressure experienced by an object under the influence of ultrasonic radiation, a unidirectional pressure exists. The depression of the surface of the object under consideration at the point of impinge-

ment of the ultrasonic wave is a measure of the rigidity of the object. The depth of this depression could perhaps be determined optically in the case of the cornea.

To further evaluate this possibility the following equation defining the unidirectional or radiation pressure are useful:

$$P_r = 1/2\ (K + 1)\ J/C \qquad (32 — p.\ 28)$$

or

$$P_r = a\bar{E} = a\ (J/C) \qquad (11 — p.\ 19,\ Eqn.\ 1.16)$$

where $J = dC/2\ (\omega A^2) = Pu/2$ (11 — p. 18, Eqn. 1.15)

and $K$ = ratio of specific heats

$J$ = intensity/cm$^2$ in unit time of ultrasonic radiation

$C$ = velocity of ultrasonic radiation

$P_r$ = radiation pressure

$\bar{E}$ = mean energy density

$\omega$ = frequency of ultrasonic radiation

$a$ = proportionality constant = $(K + 1)/2 \cong 1$

$d$ = density

$A$ = maximum amplitude of the vibration particles

$P$ = sound pressure

$u$ = maximum velocity of vibration particles

The third potential solution involves the determination of the electrical equivalent circuit of the eyeball and supporting members. Among other things this equivalent circuit would include a tuned circuit representing the natural mechanical vibration frequency of the eye. As the pressure of the eye media varied, the frequency of the tuned circuit might be expected to vary also, consequently, sweeping through a band of ultrasonic or subsonic (probably the latter) frequencies and optically observing the point of maximum eye displacement (resonance) the natural frequency of a particular eye would be determined. It is possible that such a measurement would yield results significantly different from the norm in the case of abnormal intra-ocular pressure.

None of these suggested solutions has been proven conclusively infeasible through exhaustive experimentation and rigorous theoretical analysis; however, we must consider each solution in turn in the light of the characteristics desired in the measuring instrument as predetermined in the initial control specifications.

First, it is required that the measurement be *non-irritating*. We believe that except for the absence of the psychological effect of seeing an object approaching and touching one's eye, any depression or movement of the eye caused by ultrasonic energy would be perceptible and perhaps irritating. It is important to note here that a basic characteristic of ultra-

sound is that it depends for its production on matter, and for its transmission on changing any matter in its path from a mechanically quiet into an oscillating state. It is possible that this problem could be circumvented by using energy pulses shorter than the minimum duration required for perception, however, the generation and processing of these short pulses is not inexpensive, and the entire premise of sub-perceptible impulses would have to be extensively investigated.

Second, consider the *relative* inability of ultrasound to pass through an interface of two media having widely different acoustic impedances, a problem originating with the noncontacting requirement. This does not rule out echo measurements, but it does require an amplifier capable of handling extremely small signal levels. This sensitivity coupled with the required stability is difficult but not impossible to achieve: however, the cost of the amplifier *alone* would probably result in a prohibitive price for a complete instrument.

It is also conceivable that to avoid sensation in the eye of the patient, one might reduce the impinging radiation to quite a low level. The associated optical system necessary to observe a "dent" produced by radiation pressure, or the vibration induced by sonic or subsonic resonance of the eyeball, would of necessity be of greater refinement, and likewise too expensive for practicality.

## CONCLUSIONS

While several possible methods of attack on the problem presented themselves, none seemed to fall within the scope of this project. It appears that the price limitations set forth in the control specifications rule out any adaptation of ultrasonic technique that has been suggested to date. It is quite possible that any or all of the methods may have some merit, but considerable expenditure of funds and time would be necessary to pursue any one of them.

In light of practical specifications, a conclusion of infeasible must be rendered. An unlimited cost requirement would by no means insure successful development: however, it appears that a cost of at least $2,000 per instrument is attainable, though highly impractical. In any event, it is felt that pursuit of a solution along any of the lines suggested is a university type of research, requiring a budget of no small proportions. It is with considerable regret that further efforts on this project have been discontinued.

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## BOOK REVIEW

HOW TO SUCCEED IN OPTOMETRY. Ralph Barstow, O.D. Published by Illinois College of Optometry Press, Chicago, Illinois. 2nd Edition. 319 pages with 15 graphs and illustrations. $7.50. 1959.

The 2nd edition of Dr. Ralph Barstow's book has now appeared. After several years of being out of print the 1948 edition had become a highly requested item. It was because of this need that the Illinois College decided to undertake the publishing. Under the author's direction revision was accomplished and that warmth and unique style maintained. Students and practitioners alike will be pleased to know that all of the original context has been preserved and brought up to date. Dr. Barstow takes us on a voyage simulating step by step the necessities of a professional practice: starting, location, equipment, patient control, fees, bookkeeping and thousands of other valuable points. Without question this vast store house of information will help you help yourself to success.

ROBERT W. MOORE, O.D.

1934 LOWRY MEDICAL ARTS
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AMERICAN JOURNAL OF OPTOMETRY
*and* ARCHIVES *of*
AMERICAN ACADEMY OF OPTOMETRY
Established 1924

Vol. 37 March, 1960 No. 3

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Publication and Academy Office: 1508 Foshay Tower, 821 Marquette Ave.
Minneapolis 2, Minnesota

Annual Subscription, United States and Canada, $8.00 in Advance; Foreign, $9.00; Single Copies 80c

Original papers, scientific communications, clinical reports, books for review, and correspondence should be sent to the editor. Subscriptions and applications for single copies should be addressed to the circulation manager. Copy of advertisements must be sent in by the first of the month preceding their appearance. Communications with reference to advertising or other journal business should be addressed to the advertising manager. Academy correspondence should be addressed to Dr. Carel C. Koch, Secretary of the American Academy of Optometry.

Published Monthly by the
AMERICAN JOURNAL OF OPTOMETRY PUBLISHING ASSOCIATION

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## 1960 IS THE YEAR TO "SEE YOURSELF IN HAWAII"*

Everyone planning to attend the American Academy of Optometry Convention in San Francisco, December 7-13, 1960, should also avail themselves of an opportunity of a lifetime, and that is PLAN TO SEE OUR FIFTIETH STATE—HAWAII. This additional holiday trip will truly be an exotic vacation "in the Paradise of the Pacific," in fact, "in the Paradise of the World." Many words have been written to describe our new state but the most appropriate are still those of Mark Twain: "The loveliest of islands anchored in any ocean!"

Hawaii is closer than you think . . . lovelier than you dreamed! It is full of scenic beauty and has a flawless climate. There are so many things one can do—play golf and tennis, swim, ride in a catamaran and outrigger canoe, go sightseeing, and best of all, just plain relax on the

*By Martin J. Kupper, Associate, Sedard World Travel Service, Inc., 137 South Seventh Street, Minneapolis 2, Minnesota.

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Minneapolis 2, Minnesota

Annual Subscription, United States and Canada, $8.00 in Advance: Foreign, $9.00: Single Copies 80c

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*By Martin J. Kupper, Associate, Sedard World Travel Service, Inc., 137 South Seventh Street, Minneapolis 2, Minnesota.

beautiful sandy beaches. Hawaii is truly Polynesian in tradition, truly American in its standards of living. You will certainly find all of the people gracious, courteous and most friendly. The only thing one must do is go with a happy heart and enjoy every minute of the time you will be in "Our Islands." Since statehood last March, it can be said that these Islands are even more exciting, more fabulous, more captivating than ever before.

The Academy is arranging through the Sedard World Travel Service, Inc., of Minneapolis, a very attractive post-convention itinerary for members and guests, with first class arrangements throughout. A detailed colorful brochure is available for the asking but below is a brief itinerary of your Hawaiian Holiday:

| | |
|---|---|
| Tuesday, December 6 | Transportation arrangements will be made from your home town to West Coast (make your wishes known and complete schedules and cost will be submitted). |
| Wednesday, December 7 through Tuesday, December 13 | In San Francisco attending the American Academy of Optometry Convention. |
| Wednesday, December 14 | Depart from San Francisco via JETLINER (5-hour flight) for Honolulu. |
| Thursday, December 15 through Monday, December 19 | On WAIKIKI—Accommodations at the fabulous HAWAIIAN VILLAGE Hotel. During your time on the Island of Oahu, you will take a Circle Island Tour and a special cruise to Pearl Harbor. You will also participate in the famous Hawaiian LUAU. |
| Tuesday, December 20 through Sunday, December 25 | For your enjoyment, a six-day all-expense tour to the Big Island of Hawaii and to the Garden Island of Kauai. A comprehensive sightseeing program of both islands. Accommodations provided at Kona at the new KING KAHEHAMEHA Hotel and COCO PALM LODGE on Kauai. |
| Sunday, December 25* | Depart by JET Airliner for San Francisco arriving in the evening.<br>Transportation arrangements will be made back to your home town (make your wishes known and complete schedules and costs will be submitted). |
| FEATURES: | Air transportation, twin bedded rooms with bath at hotels, sightseeing, transportation between airports, hotels and vice versa, Luau and group dinner while on Waikiki; all meals while on the Islands of Hawaii and Kauai; ALL TIPS.<br>Basis Deluxe JET: $862.00, plus $22.00 tax<br>Basis Tourist JET: $790.00, plus $22.00 tax |

Hawaii is ever popular and, therefore, you are requested to direct your inquiries to the Sedard World Travel Service, Inc., 137 South Seventh Street, Minneapolis 2, Minnesota, and a colorful booklet of the trip will be sent to you.

MARTIN J. KUPPER

*In case that you wish to be home for the Christmas Holidays, you can leave Hawaii December 23 which will reduce your stay by two days and the cost will be approximately $25.00 less per person.

## THE SEASON FOR NEW BOOKS

During the three-month period, November, 1959, through January, 1960, fourteen new books and special educational services dealing with the eye and its appendages; ocular refraction and subjects related to ophthalmic optics have appeared. Most of these new texts are in their initial editions. A few are revised from earlier printings. This is a particularly healthy sign as it again indicates a faith on the part of many publishers in the willingness and ability of optometrists and others in the eye care field to buy and read new published material. A list of these new works follows, each with a few brief comments.

**How to Succeed in Optometry.** Ralph Barstow, Professional Counselor. Revised Second Edition. Published by the Illinois College of Optometry Press, 3241 South Michigan Avenue, Chicago 16, Illinois. 319 pages. Illustrated. Cloth. $7.50. 1959. The first edition of this book dealing with the economic aspects of professional optometric practice has been out of print for some time. The new revised second edition is therefore a welcome addition to an optometrist's library as it contains very much of real value for every practitioner. The ICO Press is to be congratulated for this, their initial step in the publishing field.

**Optics and Spectroscopy.** A translation into English of the monthly Russian journal *Optika i Spektroscopiya* made possible through a grant-in-aid by the National Science Foundation. The translation is supervised by the Optical Society of America. This translation is sent free to all members of the Optical Society of America and to all subscribers to the JOURNAL OF THE OPTICAL SOCIETY OF AMERICA. Annual subscription fee for both monthly publications $25.00. Optical Society of America, 1155 Sixteenth Street N.W., Washington 6, D. C. These publications deal with new scientific developments in the field of optics. Only an occasional report touches ophthalmic optics.

**Levin Contact Lens Tables.** Published by the Louis Levin & Son, Inc., 3610 South Broadway St., Los Angeles 7, California. 136 pages. Cloth. $49.50. 1960. This series of tables has been prepared for those who make plastic contact lenses to provide them with a fast and accurate means of determining the radius of curvature of the anterior surface of the lens when the base-curve and power are known. It is also useful to those prescribing contact lenses for it will provide the measurements for checking the finished lenses. The book contains the complete listing for more than 80,000 separate contact lens surfaces.

**Encyclopedia of Contact Lens Practice.** Phillip R. Haynes, O.D.,

Editor. Bernard E. Vodnoy, O.D., Business Manager. Published by the Encyclopedia of Contact Lens Practice as a loose leaf encyclopedia with bi-monthly supplements. 801 North Michigan St., South Bend 1, Indiana. Annual subscription $19.50. 1959. Here the editors attempt to cover the many aspects of contact lens fitting with the help of a strong group of contributors. This is a major undertaking which deserves the support of optometrists.

**Synopsis of Glaucoma for Optometrists.** Arthur Shlaifer, O.D., Ph.D., Pennsylvania State College of Optometry. Volume I. American Academy of Optometry Series of Home Study Courses. Published by the Burgess Publishing Company, 426 South 6th St., Minneapolis 15, Minnesota. 88 pages. Illustrated. Board. $5.00. 1960. This new Academy book was the subject of an editorial in our January issue. The writer still thinks it is very good and we are told it is selling well and we know it is receiving much fine praise.

**Physiology of the Eye.** Clinical Application. Francis Heed Adler, M.D., University of Pennsylvania, School of Medicine. Third Edition. Published by the C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Missouri. 790 pages. 372 illustrations. Cloth. $16. 1959. In this new edition the author again to a very large degree approaches his subject of Physiology of the Eye from the standpoint of ocular disease and its effect upon function and functional disorders.

**Preschool Vision.** R. J. Apell, O.D., and R. W. Lowry, Jr., O.D. Gesell Institute of Child Development. Published by the American Optometric Association, 4030 Chouteau Ave., St. Louis 10, Missouri. 189 pages. Illustrated. Cloth. $7.50. 1959. This book deals with preventive eye care among the preschool group of children. The techniques suggested are those of the Gesell Institute. As these techniques are still very new, much of the book is given over to their suggested step-by-step review of case procedure and subsequent diagnosis. The book has been published by the American Optometric Association and should enjoy a wide distribution among optometrists.

**An Investigation of Optical Corrections for Enabling Patients With Low Visual Acuity to Read.** Jan Karel Parmeijer. The University of Amsterdam, Holland. Translated into English by E. van Maanen-Helmer. 122 pages. Illustrated. Board covers. 1959. This book is unique. It is a clinical review of the clinical ups and downs experienced by the author in prescribing sub-normal visual aids of all sorts. Case histories are given and the author reports in detail his own and the patients' reactions to the many aids tested and used.

**Handbook of Physiology.** Section I. Neurophysiology, Volume II. Editor-in-Chief: John Field; Section Editor: H. W. Magoun; Executive Editor: Victor E. Hall. Published by the Williams & Wilkins Company, Baltimore 2, Maryland. Pages 781 through 1439. Illustrated. Cloth. $20.00. 1960. This is part of a multi-volume set now being published by the American Physiological Society. These handbooks will provide a very comprehensive survey of the experimental findings and the concepts that constitute the substance of present-day physiology.

**Roentgenologic Diagnosis in Ophthalmology.** Edward Hartmann, M.D., and Evelyn Gilles, M.D., American Hospital in Paris. Translated by George Z. Carter, M.D. Edited by Conrad Berens, M.D. Published by J. B. Lippincott Company, East Washington Square, Philadelphia. 375 pages. Illustrated. Cloth. $15.00. 1959. This highly illustrated book deals with clinical problems involving the interrelationships between the specialties of roentgenology and ophthalmology.

**Lexicon Ophthalmologicum.** Editors, M. E. Alvaro, M.D., Sao Paulo; Marc Amsler, M.D., Zurich; H. Arruga, M.D., Barcelona; G. B. Bietti, M.D., Roma, and Stewart Duke Elder, M.D., London. Published by J. B. Lippincott Company, East Washington Square, Philadelphia 5, Pennsylvania. 217 pages. Cloth. $9.00. 1959. This book is published under the sponsorship of the International Council of Ophthalmology and certainly fills a long felt want. Its purpose is to provide those in the field of eye care with the translations of scientific and technical terms commonly used in the literature of this specialty in the following languages, English, German, Spanish, French and Italian with Latin added, as it frequently supplies the common root. The book is divided into six sections, one for each language. For instance, looking up the word *adduction* in the English Section one finds that in German this is *adduktion;* in Spanish, *aduccion;* in French, *adduction;* in Italian, *adduzione* while in Latin it is *adductio.* All of our school and college libraries should have this book and many of our technical writers will want this lexicon near their desks.

**Ocular Vertical Deviations and the Treatment of Nystagmus.** J. Ringland Anderson, M.D., Alfred Hospital, Melbourne. Foreword by Sir Stewart Duke-Elder, London. Second Edition. Published by the J. B. Lippincott Company, East Washington Square, Philadelphia 5, Pennsylvania. 189 pages. Illustrated. Cloth. $8.50. 1959. This book deals with the use of surgery and orthoptics in vertical imbalances

of the extra ocular muscles along with a brief discussion of nystagmus. The author has done a lot of work in this field and optometrists interested in orthoptics will probably enjoy reading this book. All-in-all, however, it is a dreary subject, as we do not seem to have the techniques to cure these cases.

**Synopsis of Ophthalmology.** William H. Havener, M.D. Chairman, Department of Ophthalmology, The Ohio State University. Published by the C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, Missouri. 288 pages. Illustrated. Cloth. $6.75. 1959. This is another of the many texts dealing with general clinical practice of ophthalmology. There is little here for the optometrist.

**The Principles and Practice of Refraction.** G. H. Giles, F.B.O.A. (Hons.). Published by Hammond, Hammond & Company, 87 Gower St., London, W.C.1., England. Cloth. £5.50 net. 1959. Giles is well known on both sides of the Atlantic as the author of *The Practice of Orthoptics* (1947). This new book covers the entire field of technical and clinical optometry. It contains about 700 pages of well written material divided into 36 chapters, all but five written by the author. The other chapters are contributed by D. Mitchell, R. Fletcher, R. Bannon, L. Sasieni and F. Dickinson on specialized subjects. This new book should prove popular with optometrists everywhere.

Optometrists, like other professional men, are in part judged by their tastes in reading and by their libraries and the way they keep these libraries up-to-date through the addition of new books, educational services and magazines. Every professional office should contain a library of modern texts and journals to which the optometrist can turn as the need arises to stimulate and refresh his mind on the many aspects of modern practice. We are sure the list of new books and educational services presented here will suggest to the reader several new additions of value to him.

CAREL C. KOCH

SPECIAL REPORT

# THE USE OF CONTACT LENSES IN ADOLESCENT MYOPIC PATIENTS*

Robert Jay Morrison†
Harrisburg, Pennsylvania

Myopia has been a problem to the optometrist since the beginnings of refraction. There have been many attempts to retard the progression of myopia by such procedures as vision training, vitamin therapy, and the use of bifocal lenses for children. Youngsters almost invariably require stronger spectacle lenses as they physically mature in order to see clearly and function with visual efficiency.

The congenital type of myopia is often constant. This variety is usually high in amount and is evident early in life. Nearly all myopia which appears after age 5 continues to progress until body growth ceases. A leveling off is usually present between the ages of 18 to 25. However, some individuals continue to increase in amount of myopia to later years or for the rest of their lives.

Some years ago, the writer noticed that his routine six-months' re-examination of nearly all contact lens patients seldom resulted in the need of a power change in the contact lenses to achieve the same visual acuity as that recorded when the patient was originally discharged. If the patient reported daily constant wear, there was rarely, if ever, need of a power change. It seemed to be worthwhile to prescribe contact lenses for children whose eyes were free of pathology but had myopia that was progressing.

Lenses known as the "corneal" and "micro" type were prescribed at this time. Both of these types were prescribed with a flatter radius of curvature than that measured by the keratometer or ophthalmometer. The average amount of flattening on the corneal type was 1.62 diopters. The average amount on the micro type was 2.50 diopters. The diameters of the corneal lenses varied between 10.2 and 12.3 with 11.5 being the average. The micro type varied between 8.8 and 10.0 with 9.3 being the average. All of these lenses were single curve. Many had a bevel ground on the periphery to alleviate symptoms and to attempt to improve the contact lens-cornea relationship.

*Read before the annual meeting of the American Academy of Optometry, Contact Lens Section, Chicago, Illinois, December 13, 1959. For publication in the March, 1960, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Optometrist, Fellow, American Academy of Optometry.

After two years of following a group of these children, I decided to write a preliminary report on this study. I felt, and still feel, that many years of careful, organized study will be required before the value of this therapy can be determined. I decided to make this early report to my colleagues for three reasons:

1. To date, I had not found one case, either in my practice or in literature, in which contact lenses had done lasting harm to the eye or to the integrity of the cornea.
2. The constant daily wearing of contact lenses now appeared to have an actual therapeutic value, wherein other methods of arresting myopia have generally failed.
3. On the basis of information obtained from the parents of these patients, most youngsters enjoyed new-found confidence and had excellent psychological reactions in wearing contact lenses.

The preliminary report was published in the JOURNAL OF THE AMERICAN OPTOMETRIC ASSOCIATION and a subsequent report was published in the journal, CONTACTO. As a result of these articles, and subsequent items carried by TIME and PAGEANT magazines, many newspapers and other media, I received a great number of letters from optometrists and ophthalmologists throughout the world.

Letters and subsequent events varied. Many of my correspondents began enthusiastically, and yet with caution, to employ this new therapy in their private practice. Others were skeptical. Some used the report commercially, even exaggerating the findings. But all were interested. I received many invitations to lecture on contact lenses and this new work and I was able to accept many invitations to speak while in Europe.

Although the texts of my talks varied according to the groups, I found the interest in the myopia study high in every land. I also noted that of all the questions asked me, many were repeated wherever I went. I made notes of the most frequent questions, and would like to review them.

I was careful to identify my answers as my own, and not those of any group. I made it plain that careful further study was being made and is, in fact, required. I stated that we have much to learn about this new work and that, for whatever they were worth, the answers were my personal opinions:

Q. What age must the patient be when you begin this work?

A. As early as possible, but seldom before age 6. I have prescribed for as young as age 4, but I find that, before 6, youngsters cannot handle the lenses well.

Q. At this early age, are you more successful with one sex than the other?

A. The success is approximately equal. However, I have noted that more time and patience is required with the male at the same age. For example, males at age 8 handle the lenses as well as females age 6.

Q. What is your approach to the parents when you decide to prescribe contact lenses?

A. I explain the newness of the work. I make no promises. I explain all the ramifications of contact lenses, their adaption and use. I emphasize that they do no harm, but offer hope in arresting myopic progression and are psychologically very good.

Q. Your first reports indicated that you were prescribing corneal cap type lenses flatter than the curvature of the cornea as measured by the ophthalmometer and keratometer. Do you still follow this mode of prescription?

A. I try to prescribe as close to alignment with the curvature of the cornea as possible, as determined by biomicroscopy and fluorescein dye pattern study. Generally speaking, the base curve of the contact lens I now prescribe is close to the flattest reading taken by the keratometer or ophthalmometer.

Q. Have you prescribed lenses steeper than these readings, and, if so, what has been the result?

A. The cornea tends to move into the space a steeper lens creates. The normal cornea behaves much like a conical cornea when the space is created between the apex of the cone and the inside of the contact lens.

Q. What happens to the myopia if the lens is prescribed steeper than the curvature of the cornea?

A. The myopia first increases slightly, then an apparent holding effect takes place.

Q. Now that you prescribe parallel, do you find the results as conclusive as when you were prescribing flatter?

A. The results are similar. Now and then, an increase in minus is noted, usually slight in amount. Once the full amount of minus is prescribed and six months have elapsed without a change in visual acuity, a change in prescription will seldom be required. I do not consider changes in early wear as significant.

Q. Does the refractive error in the hyperope also remain constant?

A. Generally it does. However, the progression of hyperopia has not been the problem that myopia has been and my organized studies have concentrated on myopia.

Q. What are your criteria for feeling that the error has not changed?

A. That the patient's visual acuity, after a year or more's use of contact lenses, is the same as it had been upon the completion of the prescription. Also, that the subjective and static retinoscopic observations are the same.

Q. Under-correction of minus power has been a popular mode of treatment for the spectacle wearing myope. Do you under-correct your contact lens patients?

A. I always give the full minus power that I find with the retinoscope, or as much subjective minus as the patient requests, as long as the letters on the 20′ distant chart do not appear smaller.

Q. Do you think you might be over-correcting these youngsters in minus power?

A. It is certainly a possibility. Especially before the advent of toric and cylindrical contact lenses, when the residual astigmatism prevalent in most contact lens patients might cause distant blurring, I would subjectively add more minus power to attempt to be closer to the middle of the interval of Sturm. Also, other factors such as clinical error and spasm due to photophobia may result in an over-correction. It is hard to conceive of this over-correction being great, both because the patient would probably complain of discomfort at near application, and the retinoscopy should indicate this. The fact that a number of patients wearing lenses constantly for 9 years without a change in power but still with the same visual acuity seems fairly convincing that, if over-corrected a bit, they would have passed this over-correction by now and would require more minus power. However, I repeat that this is a possible factor which must certainly be considered.

Q. After the progression of myopia has been arrested by the use of contact lenses for a year or more, what happens if you remove the lenses for a year?

A. To date, I have not been successful in having a group of patients do this long enough to make a documented report. As a rule, the patient and parents are enthusiastic with the results, and do not care to risk renewing myopic progression by withdrawing contact lenses.

## CONCLUSION

The writer is continuing to prescribe contact lenses for myopic

children with explanations to the parents concerning the newness of this work, and without any promises of retardation. I feel that not all myopes will be retarded, but that the constant wearing of contact lenses results in eliminating the need for additional minus power in the contact lenses of most constant wearers.

Control groups have been formed under my supervision at the University of Indiana and in Harrisburg, Pennsylvania. Indigent children of similar environment at various age levels have been selected for controlled group study. There will be a duplication of the project in each of the two cities: in each locale, one group will wear spectacles; the other contact lenses. Procedures will include careful case history study, body, height and weight measurements with emphasis on heredity, environment and habit, refraction, charting and evaluation in addition to measurement of the axial length of the eyeball. It is planned to remove the contact lenses from half of the groups at the end of two years and to continue observation on both groups in subsequent years.

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## CURRENT COMMENTS

Terry Judith Parkins
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department; such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

### ALBERT FITCH

Dr. Albert Fitch, 80, Philadelphia, founder and president of the Pennsylvania State College of Optometry, died February 13 after an illness of several months. Dr. Fitch was the last active administrative college head of a former group of optometric educational leaders who had developed our present series of splendid optometric under-graduate professional schools and colleges. Active in administrative affairs of P.S.C.O. until his last illness Dr. Fitch leaves behind him a lasting monument to his faith in good education in the form of P.S.C.O. with its splendid plant and campus, its excellent faculty and the thousands of loyal alumni in active practice. His vigorous championing of all things optometric will live in the folklore of optometry for all time to come and the memory of his many optometric victories will always be part of optometric history. Dr. Albert Fitch was an Honorary Life Member of the Academy.

ERNEST PETRY

Dr. Ernest Petry, 78, former dean of the Rochester School of Optometry, died on January 6, 1960, at his home in Irondequoit, Rochester, New York. He served as Dean of the School from 1911 to 1928 when the school became part of the University of Rochester. Following this merger Dr. Petry served on the technical staff of the Bausch & Lomb Optical Company until his retirement in 1947. Dr. Petry was one of the original group of optometrists who founded the American Academy of Optometry in 1921.* He has been active in the Academy since that time. The Rochester School of Optometry was, of course, the work of many men. The man chiefly responsible for its growth, development, its fine schedule of courses and faculty was Dr. Ernest Petry. His many former students and friends in optometry mourn his passing.

MARY L. CLAY

A bequest of $500 provided for in the will of Dr. Mary L. Clay was recently received by Indiana University for the use of the Division of Optometry. A native of Allen County, Dr. Clay died on July 14, 1958, in Fort Wayne, where she had practiced optometry for over thirty years. She was a 1921 graduate of the Northern Illinois College of Optometry. Dr. Clay was a member of the Plymouth Congregational Church and belonged to the Quota Club and the Quarter Century Club. Optometrists of Indiana remember her fondly as a faithful member of the Indiana Optometric Association, as an honored Fellow of the American Academy of Optometry, and as a staunch supporter of all good things optometric.

NATIONAL BOARD OF EXAMINERS IN OPTOMETRY

Dr. John R. Uglum, Reno, secretary of the National Board of Examiners in Optometry, announces that the 1960 National Board Examinations will be held on May 13-14 at all schools and colleges in Optometry in the United States. Application forms may be secured from the Deans or by writing directly to Vergie Ramig, administrative assistant, National Board of Examiners, P.O. Box 44, Mitchell, South Dakota.

BOOK ON VISION SCREENING WINS DESIGN HONORS

*"Vision Screening for Elementary Schools: The Orinda Study"* has been selected as one of the outstanding Western Books of 1960 by the Rounce & Coffin Club. (The Rounce & Coffin Club is an organiza-

*Report of the 4th and 5th Annual Conventions of the American Academy of Optometry. Transactions of the American Academy of Optometry, Volume 1, pages 15-16, 1925.

tion devoted to the encouragement of fine printing. Each year it chooses a group of books manufactured in the West which are of special merit.) The volume was written by Henrik L. Blum, Henry B. Peters, and Jerome W. Bettman. It was designed by Stephen King and published by the University of California Press. It presents the results of a unique cooperative study designed to prepare a workable and efficient vision screening program for general use. The price of the volume is $3.75 and it is available from the University of California Press, Berkeley 4, California.

### PRECISION-COSMET CONTACT LENS PATIENT RECORD ENVELOPE

Precision-Cosmet Company, Inc., Minneapolis, is now offering a new Patient Record Envelope for contact lens practitioners. The envelope has been designed to record complete patient history and case information. The reverse side provides space for a record of patient visits. J. Russell Conlon, P-C's general sales manager, cites the growing demand for a complete patient history record "so vital to a complete understanding and professional handling of the individual patient." The unique 6" x 9" Patient Record Envelope is printed both sides, two-tone green on white, with thumb cut-out at the open end. Envelopes are $6.75 per hundred and may be ordered from P-C's Educational Department, 529 South 7th Street, Minneapolis 15, Minn.

### INTERNATIONAL OPTICAL LEAGUE

The International Optical League will hold its annual meeting in Madrid, Spain, May 2-7, 1960. Optometrists from the United States and Canada are invited to attend. The Thomas Cook & Son Company, 166 North Michigan Ave., Chicago, have been appointed the official travel agents for this event. Optometrists wishing to attend should contact the travel agency for convention information and travel data at once.

### DATES SET FOR FIFTH CONTACT LENS CONGRESS

The Eye Research Foundation, Chicago, announces the following dates for the 5th National Contact Lens Congress. New York City, Biltmore Hotel, October 30-31; Chicago, Sheraton Towers, November 13-14 and San Francisco, Jack Tar Hotel, November 20-21, 1960. The program will be announced later.

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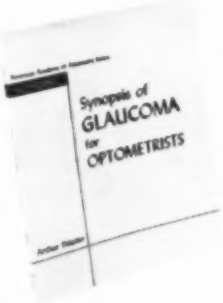


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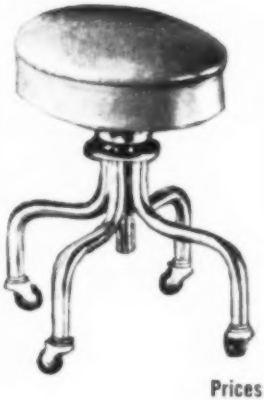

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